APR 12 1911

April 11, 1911.

POWER

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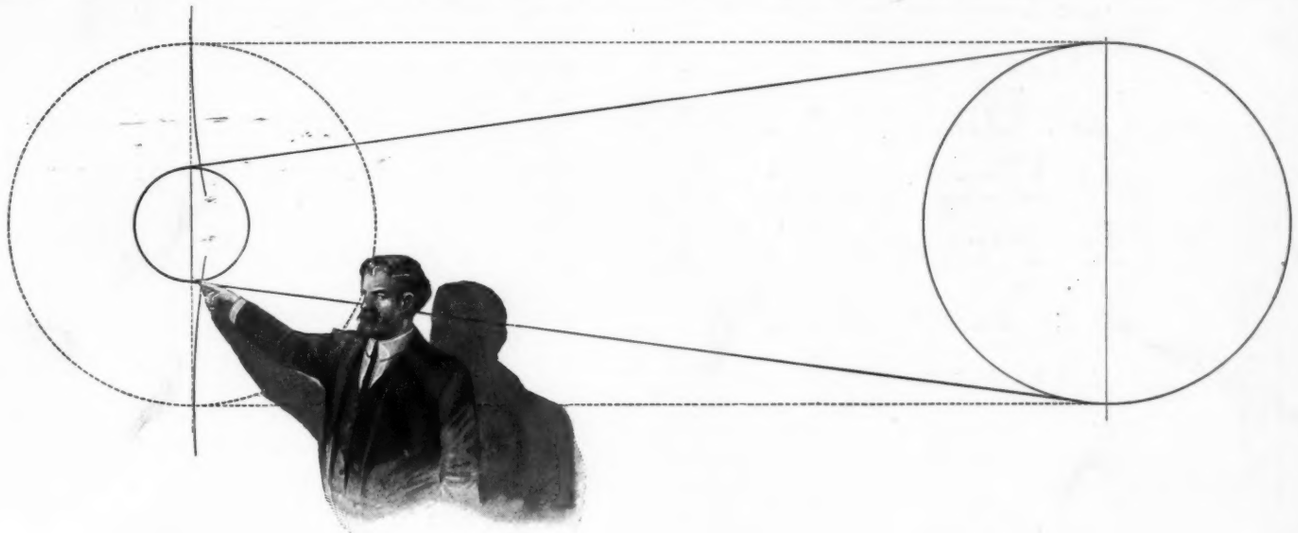

THIS diagram shows why measurements for belting should be made with a steel tape carried over the pulleys. Every one knows that where the pulleys are of different sizes the length of belt from the center lines at their peripheries is longer than it would be if both pulleys were of equal diameter. Schieren's "Duxbak" Waterproof Leather Belting would stand the extra strain exerted to stretch it over badly measured pulleys, but the friction load on the shafting would be unduly increased and the full benefit of using a belting that runs slick when slightly "slack" is lost. Remember every "Duxbak" Belt is guaranteed to be water and moisture proof and to be the best power conveyor ever marketed.

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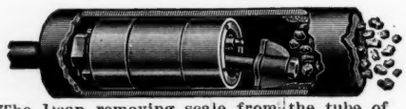
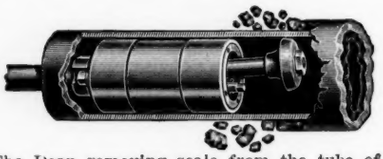


The Dean removing scale from the tube of a water tube boiler



The Dean removing scale from the tube of a return tubular boiler

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Write for catalogue.

POWER

NEW YORK, APRIL 11, 1911

THERE are many kinds of pessimist (which is the parlor substitute for such terms as "croaker," "calamity howler," "grouch," etc.)

First, there is the amateur. His case is seldom hopeless if treated properly in the early stages. The primary cause is usually a languid liver or some other temporary physical failing. When a person is troubled in this way, even a slight run of hard luck may serve to put him in the dumps of despair. But, a liver pill or a spring tonic soon re-establishes his mental equilibrium and he gets safely over his distemper.

Then, there is the professional—the chronic kicker. You can depend upon him to ferret out an excuse for complaint every time and to make the best possible use of it when he does. To express it mildly, the habitual howler is a nuisance and sometimes even a positive danger.

The amateur pessimist usually thinks that the trouble is with himself; the professional is positive that it is with the world.

If you tell old "Steady Grouch" of some pet project you have in mind or of some ambition you hope to be able to realize by dint of hard work, he will see instantly a thousand things to thwart you and will knock a lot of enjoyment out of telling you how impossible it is for you to realize your "dreams" as he probably would call them.

Optimism is an asset. Perhaps faith is a better name for what we mean—faith in ourselves, in our own ability, in our friends, in our assistants and in the man "higher up."

During the late lamentable "financial stringency" one of the "foolish" papers "did" the cleverest thing. Just at the time when all of us were dragging our weary selves around with the fear of rank ruin written in every wrinkle of our faces, *Judge* came out with a full-page cartoon which "hit off" the condition of the business world to the "queen's taste." The picture showed a group of men standing about looking at a cake—a circular doughnut, to be perfectly frank with you. One member, rotund and jovial, was urging the others to keep their eyes on the doughnut and not to mind about the hole. Good, wholesome advice, that, and well worth practising right along.

It doesn't do anyone a bit of good to think so hard about the hole in his cake that he forgets to eat and enjoy the cake itself. Not only is such practice bad for the man himself but it also has a bad effect upon those with whom he comes in contact. Deny it though you may, the fact remains that all of us are strongly influenced by our companions and our environment.

By the same token, then, each of us has his influence on his companions. Keeping this in mind, is it not more profitable to be a "booster" than a "knocker"? We guess yes.

After all, this is a good old world and right down in our hearts we're glad we're here. This being so, why not mention the fact now and then to someone who seems to have forgotten it temporarily?

Gas Engine Waste Heat to Turbine

By Edwin D. Dreyfus*

The economies to be effected by running low-pressure steam turbines in connection with gas engines are considered, as influenced by investment as well as by heat recovered. The turbine may be designed to use steam of two pressures, a primary supply at from one to three atmospheres generated by the heat of the gases and a secondary lower pressure supply derived from the jacket water and introduced at later stages.

*Commercial engineer of the Westinghouse Machine Company.

Composite power plants containing independent sections of steam turbine and gas-engine generating equipment have heretofore been shown to establish a very economical arrangement for the production of electrical energy from stores of latent heat. As observed, this plan would prove of advantage for swinging loads and low load factors—the gas-power division to be operated constantly near normal capacity and the fluctuation and peaks absorbed by the steam installation.

It is patent that gas engines rapidly decline in efficiency on loads less than 50 per cent. of their rating and, moreover, their greater first cost generally demands a large output to reap commensurate returns on the investment.

The high thermal efficiency of the gas engine is well known, but the large steam turbine has also developed remarkable economies so that the internal-combustion motor only excels in the moderate and small units.

When the combining of turbines and gas engines in a single station was first proposed, it was with the intention of using high-pressure steam, requiring the installation of boilers, stokers and additional coal-handling machinery, which entails greater labor expense and standby losses. It was suggested at that time, however, that the gas-engine waste heat be applied to the feed water of the steam section.

Since the advent of the low-pressure turbine, it has become feasible to economize the waste heat of the gas engine in exhaust heaters and utilize the energy directly in the turbine without the introduction of high-pressure boilers and coal-burning furnaces in the plant. Furthermore, the heat so conserved may be stored in large tanks, analogous to the system outlined by A. M. Hunt in the April, 1910, *Proceedings* of the American Institute of Electrical Engineers, for high-pressure operation in emergency stations, and used in bulk for peak demands.

Based upon the actual performance of the component elements of such an amalgamated plant, the following results may be readily achieved:

For Continuous Operation

(*a*) Employing the exhaust heat only, 6 to 8 per cent. heat saving over the existing economy of the gas engine.

(*b*) Abstracting heat from both the engine exhaust and jackets, 10 to 14 per cent.

For Peak Load Operation

(*a*) Storing heat from the exhaust over periods several times the duration of the peak, enables heavy overloads to be sustained, resulting in appreciable reduction in investment for the maximum demand, 15 to 30 per cent. normally, in addition to the fuel saving.

(*b*) Operating with intermittent storage, the variable swings may be loaded on the turbine and the engine and producers operated under the most favorable conditions. Ultimate improvement about 15 per cent. in heat consumption and a reduction of 12 per cent. in investment. Moreover, the auxiliary low-pressure turbine would act as a reserve unit to relieve, partially or fully, any temporary embarrassment of the engine.

Heat Storage

If a widely changing load should be experienced, providing a *low loading factor,* the installation of the auxiliary plant for continuous operation may likely prove inadvisable, as the fuel expense may bear only a small relation to the total cost. But by accumulating the primary waste heat in a storage system and utilizing it in a simple and comparatively inexpensive low-pressure turbine auxiliary, this arrangement will lend itself to reducing the burdensome capital charges.

The conditions where the auxiliary low-pressure turbine may be profitably installed, may be divided mainly into two classes:

Case I. Low-pressure turbines operating continuously with uniform load on the plant, as exists in most industrial works.

Case II. Widely varying load on the plant, with the low-pressure turbine in conjunction with a heat-storage system, serving only the peak swings of the load. (a) Fixed peaks, as in central lighting stations; (b) irregular peaks, such as occur on an interurban railway with infrequent service.

Uniform Plant Load

The value of a waste-heat power installation for steady service may be readily appreciated; and the accompanying general layout, Fig. 1, shows the principal elements of the plant.

From a practical standpoint, it would not be warrantable to employ for *continuous operation* a smaller low-pressure turbine auxiliary system than 150 kilowatts, which would serve a 1400-kilowatt normally rated engine plant.

The low-pressure turbine system will cost $45 to $60 per kilowatt installed, the smaller size naturally being the larger in unit cost. A four-unit gas plant would represent an investment of $130 to $140 per kilowatt with units 300 to 500 kilowatts in size. The entire plant unit cost will be reduced about 6¾ per cent., which will, in itself, not greatly affect the cost of a kilowatt-hour generated.

Where the price of fuel is a serious factor in a plant, such an installation as that outlined may commend itself.

Peak-load Operation

Gas engines have very limited overload capacity in addition to suffering greatly in economy on the light loads. Their initial costs also produce high fixed charges on low load factors. This auxiliary system, using heat storage, should prove decidedly beneficial if not a complete panacea for these ills. A tank is provided as indicated by dotted lines in the lower left-hand corner of Fig. 1 and as no use would ordinarily be made of the jacket heat in this case the low-pressure boiler *D* of the first case would be eliminated. Obviously, the size of the low-pressure turbine unit would be affected by the extent and duration of the station peak.

On the basis of employing the exhaust heat only, and figuring storage efficiency at 85 per cent., the loss being due to radiation, the percentage of overload that may be obtained above the normal rating of the plant, is plotted in Fig. 3 a. For example, if a three-fourths hour peak is to follow six hours full-load operation, the overload capacity the plant would be capable of sustaining would be 60 per cent.

As it is unusual in commercial operation for full load to obtain for a period of six hours preceding the time of maximum demand on the plant, Fig. 3 b has been included so the approximate entire overload capacity for varying average fractional-load operation may be

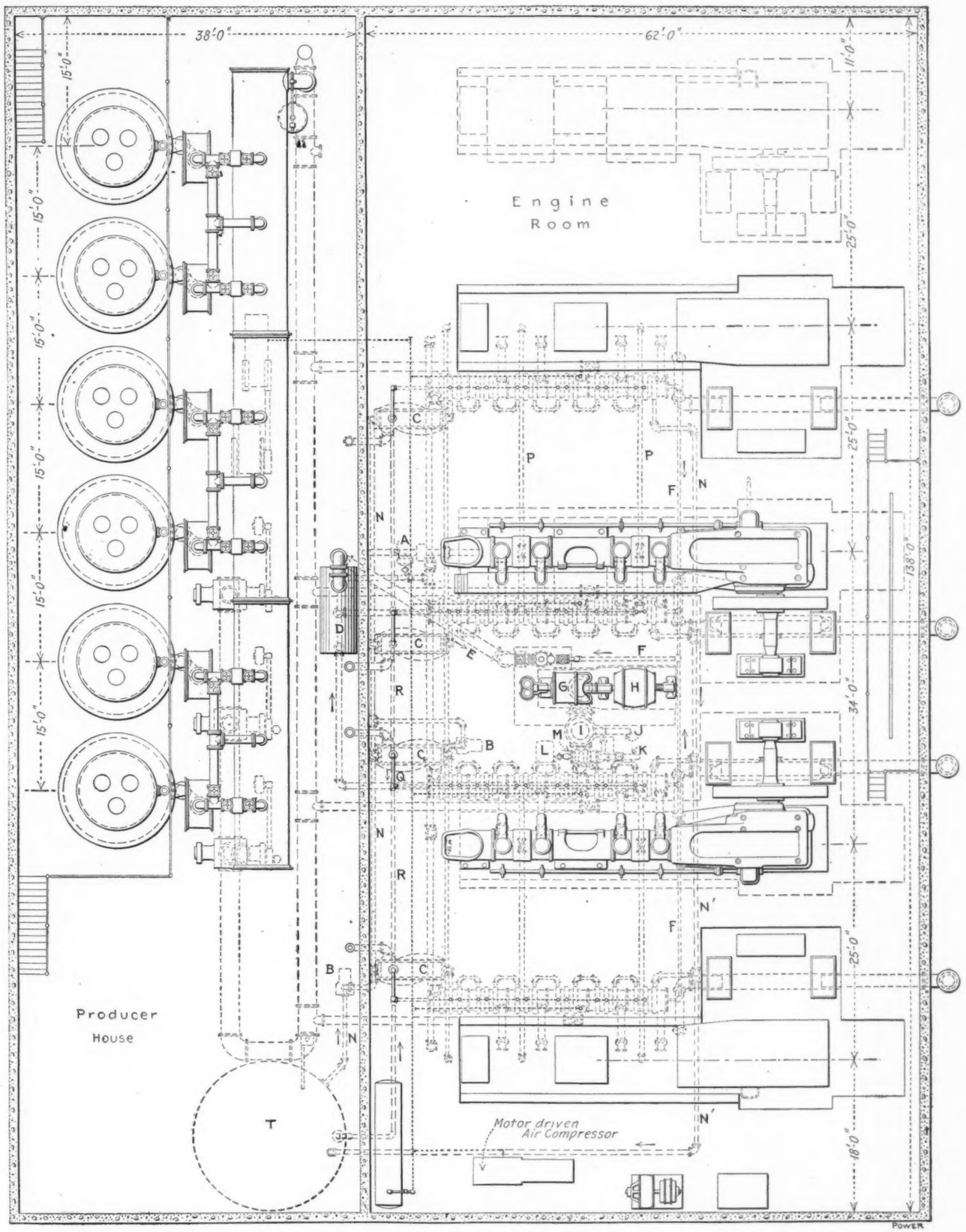


FIG. 1. GENERAL LAYOUT OF A WASTE-HEAT POWER INSTALLATION

A, Jacket water circulating pump.
B, Exhaust heater feed pump.
C, Cast-iron exhaust heater.
D, Low-temperature boiler.
E, Secondary steam line.
F, *N* and *Q*, Primary steam line.
G, Low-pressure turbine.
H, Generator.
I, Jet condenser.
J, Condenser injection pipe.
K, Condenser discharge pipe.
L and *M*, Motor-driven air and circulating pumps.
P, Jacket-water circulating system.
T, Storage tank.

readily derived graphically from Fig. 3 a. For illustration, if the plant had been running at three-quarters load for six hours and was to sustain a three-fourths hour peak, it will be found from Fig. 3 a that 60 per cent. overload could be sustained by the turbine. Taking, then, the 60 per cent. vertical ordinate and extending it horizontally to the 75 per cent. load diagonal, Fig. 3 b, 55 per cent. is obtained—this value including the 10 per cent. overload capacity of the gas engines. For other conditions, manifestly the same course is to be pursued. It is to be observed that the percentage of peak to be determined in each case represents the average of the period over which the low-pressure turbine operates. The maximum will therefore undoubtedly exceed the values given, especially if the maximum swing occurs during the first half of the time so that the tank temperatures will not be too low to operate the turbine on overloads. For peak-load conditions, plants as small as 500 kilowatts in engine capacity, may well include the byproduct power system.

These charts, therefore, facilitate the predicting of possibilities for any combination of conditions, but each individual case should be treated specially to definitely prove its merits.

The actual gain in fuel economy in this system will depend upon the true nature of the load curve. Where a peak of steep character and of very short duration occurs frequently and at indefinite times, the improvement in operation may be 15 to 25 per cent., as the engines will not have to be run underloaded normally so as to sustain the heaviest swing. With a widely changing load, as in some interurban railway systems, sufficient time may not elapse for adequate heat storage between peaks.

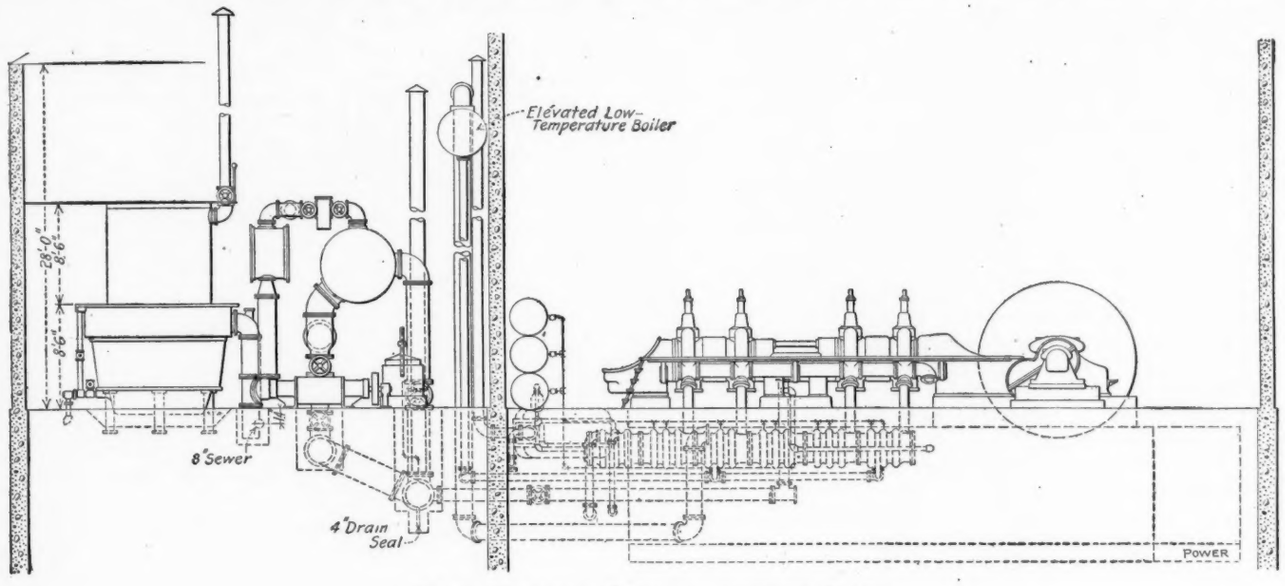


FIG. 2. SECTIONAL ELEVATION THROUGH PLANT

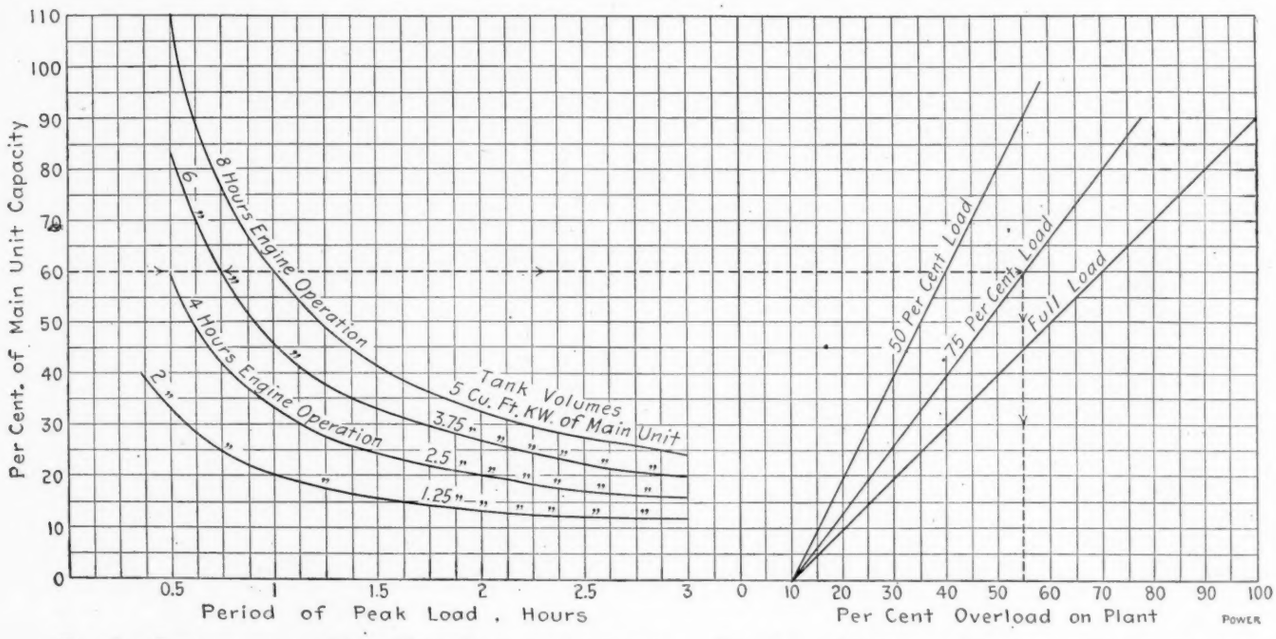

Per Cent. of Main Unit Capacity
Period of Peak Load, Hours
8 Hours Engine Operation
6 " " "
4 Hours Engine Operation
2 " " "
Tank Volumes
5 Cu. Ft. KW. of Main Unit
3.75 " " " " " "
2.5 " " " " " "
1.25 " " " " " "

FIG. 3a. PERCENTAGE OF MAIN UNIT CAPACITY AVAILABLE FROM LOW-PRESSURE TURBINE OPERATING ON GAS-ENGINE WASTE-HEAT STORAGE SYSTEM. FOR FULL-LOAD OPERATION PRECEDING PEAK

FIG. 3b. CHART FOR OBTAINING THE PERCENTAGE OVERLOAD CAPACITY OF GAS PLANT AND LOW-PRESSURE TURBINE FROM FIG. 3a FOR FRACTIONAL-LOAD OPERATION PRECEDING PEAK

The influence on costs works out in an interesting way. A four-unit gas plant, aggregating 1200 kilowatts, or more, will require an investment of approximately $135 per kilowatt, including buildings and plat. An installation of a low-pressure turbine system with condenser, tanks and piping, would approximate $45 per kilowatt. Therefore, if the station is to carry a 50 per cent. peak, of which 40 per cent.

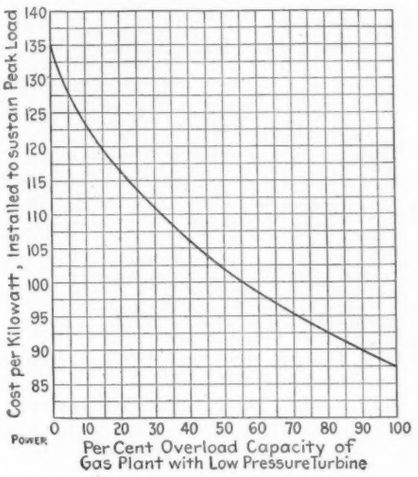


FIG. 4. DECREASED COST PER KILOWATT, DUE TO INSTALLATION OF LOW-PRESSURE TURBINE

is taken by the low-pressure turbine and 10 per cent. by the engines, the average cost becomes,

$$\frac{135^*}{1.10} \times \frac{110}{150} = 90$$

$$45 \times \frac{40}{150} = 12$$

$$\$102$$

This average corresponds to a reduction of $20.75 per kilowatt, or 16.9 per cent. For convenience, a number of values for other ratios have been determined and are given in Fig. 4.

If the low-pressure turbine is to be operated to supply peak loads only, but must be in operation continuously to absorb any sudden load increase, it will probably be warrantable to utilize the jacket heat to supply the no-load losses, as well as pump and condenser auxiliary power. The no-load steam consumption of a turbine is from one-fifth to one-sixth that of full load. As one-third of the work is obtained with the jacket heat, as brought out in the first case, the installation of a secondary system will contribute materially toward decreasing the power losses of the turbine running idle. In this manner, the low-pressure turbine system would be analogous to a storage battery floating on the line. The plant arrangement would be one which would combine the features of Cases I and II.

POSSIBLE SAVING

To demonstrate the value of this combination of gas engines and low-pressure turbines, studies of specific cases are included. For one example, a typical central lighting station load has been considered. Where central-station development is properly conducted, the character of the load curve should be more or less similar for the average city, and a form of load curve as given in Fig. 5 has been chosen. As previously shown, at least 7 per cent. of the gas-engine output may be obtained in the low-pressure turbine. To cover all contingencies, 6 per cent. has been used for this particular example.

Integrating the entire load chart and determining a peak-load area (6 per cent. of the area representing the gas-engine output) the portion of the load that the turbine may carry is indicated by the cross-hatched area. This shows that three 500-kilowatt gas engines and one 500-kilowatt low-pressure turbine may be installed in place of four straight gas-engine equipments. The gas plant, including building and real estate, would cost, at $135 per kilowatt, $270,000. A low-pressure turbine and auxiliaries, including low-temperature boiler, may be added without increasing the building or land cost and may be set up at about $50 per kilowatt, or, with the three gas engines, the entire plant would represent only $227,500 investment, a difference of $42,500. At 11 per cent. fixed charges* (5 per cent. interest, 4.5 per cent. depreciation—18 years' annuity—and 1½ per cent. insurance and taxes), the decreased yearly capital expense would be $4675.

As regards fuel saving, 6 per cent. would be conserved from the exhaust heat. The engine load factor must be improved, saving fully 4 per cent. additional. There would obviously be few producers standing by for peak load, and it may be safely estimated that a further saving of 5 per cent. may be secured from the elimination of a greater part of the standby losses. Thus the total improvement in fuel economy should equal 15 per cent. For such a plant-load curve as that shown in Fig. 5, the load factor for the winter months is 50 per cent., and for the summer months 30 per cent. The average should be over 40 per cent. where the winter months predominate. Therefore, the 2000-kilowatt plant at 40 per cent. load factor would generate (2000* × 8760 × 40 per cent.) 7,008,000 kilowatts per annum. The approximate coal curve for a four-unit plant, where the units would be placed in and taken out of service to correspond as closely as possible with the load variations, and including auxiliary-power losses, is given in Fig. 6. At 40 per cent. load factor, the average coal consumption per kilowatt-hour becomes about 2.8 pounds. This represents

$$\left(\frac{7{,}008{,}000 \times 2.8}{2{,}000}\right) = 9{,}811$$

tons per annum, which, at $2.50 per ton, delivered, amounts to $24,528. By reducing the fuel consumption 15 per cent., the saving would be $3679. The total decrease in annual expense would be $4675 plus $3679, or $8354, regardless of labor. Capitalized at 11 per cent., this represents a decrease in investment of $75,900, which is about three times the cost of the turbine equipment. Or it might be stated that the low-pressure turbine system, if adopted for the fourth unit, would pay for itself in three years by the saving produced over and above the investment and operating cost of a fourth gas-engine unit.

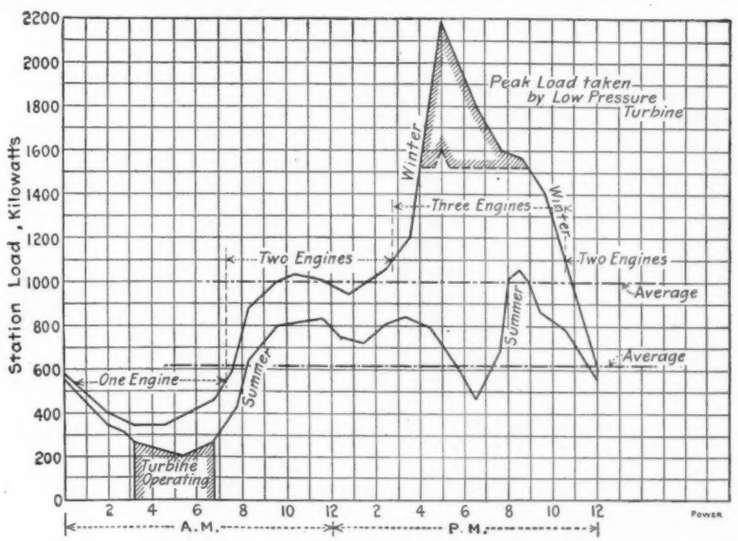


FIG. 5. TYPICAL CENTRAL-STATION LOAD CURVE. EXHAUST HEAT ONLY UTILIZED

Fig. 7 is an illustration of what may be accomplished with a swinging load, as in interurban-railway service, the curve being an actual one taken from a

*Reducing to cost per kilowatt, maximum rating, $122.75.

*This would be greater if allowance were made for supercession.

*For simplification, load factor is based on the normal rating of the plant.

station log. Engines would be improved 10 per cent. in economy, 9 per cent. would be saved by using the exhaust and jacket heat, and probably 3½ per cent. in the producer, totaling 22½ per cent. By carrying a 35 per cent. overload, the investment cost would also be lowered about 12 per cent. A curve of temperatures is plotted in this figure, showing the variation in the storage tank with load throughout the day.

It is understood that in Germany, particular activity has been displayed in this direction, and the possible gains which have been herein portrayed, have there become a matter of fact in actual installations.

Operating Conditions

In the preceding calculation, ample supply of condensing water at an average temperature of 70 degrees is assumed. With lower water temperatures, the results would obviously improve. On the other hand, if either the natural water supply is warmer or cooling towers are demanded, the attractiveness of this type of plant rapidly diminishes, which is emphasized by the theoretical water-rate curves, Fig. 8, for varying vacuum. This is essentially true for Case I, while Case II may show warrant for existence even under this condition.

All estimates are purposely made conservative in order that the advantages assumed may be realized in practice. Improvements in the detail apparatus may follow and refinements be introduced which will produce greater benefits than have been indicated.

The application of an amalgamated generating equipment of this nature will, it is believed, be confined to stations of 10,000 kilowatts aggregate capacity and less, due to the low fuel, labor and investment costs of the large turbine plant.

To facilitate a working understanding of the details involved in developing a combined gas-engine and low-pressure turbine equipment, the fundamental factors have been discussed at length below.

Power Developed in the Low-pressure Turbine

For all practical purposes, the heat distribution in the internal-combustion engine may be considered evenly divided between mechanical conversion (and radiation), the exhaust and the jackets. With an engine consuming about 10,000 B.t.u. per brake horsepower-hour at full load, the exhaust heat (33⅓ per cent. of the total) applied in a low-pressure boiler, with 70 per cent. efficiency, will produce, roughly, two pounds of atmospheric-pressure steam.

To facilitate a ready understanding of the accompanying deductions, the ideal water rates of steam motors, based on the Rankine cycle for different initial temperatures and vacua, are given in Fig. 8.

Expanding from atmospheric pressure to a 28-inch vacuum, the theoretical steam consumption is 15.2 pounds per horsepower-hour. A small steam turbine may be designed with a conversion efficiency of 65 per cent., hence would actually require 23.4 pounds per brake horsepower-hour at its normal rating. Consequently, the two pounds of steam generated from the engine exhaust may be applied in the turbine to develop $\frac{2}{23.4}$ or 8.54 per cent. of the power produced

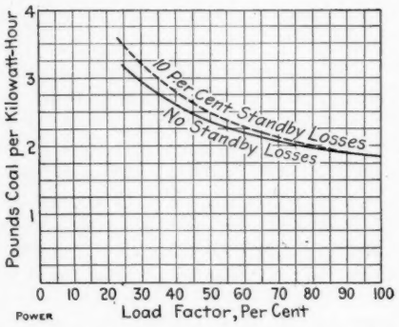


Fig. 6. Effect of Load Factor on Coal Consumption of Four-unit Gas-engine Plant

in the main engine. This percentage would be practically correct where a turbine of 500 kilowatts capacity may be used, and obviously smaller and greater, respectively, for corresponding sizes of turbines.

There is an equal amount of heat available in the jacket at a lower temperature head, and with consequently less potential energy above the condenser pressure.

The problem of utilizing this low-tension steam and obtaining it conveniently from the jacket water is not a difficult one. It is entirely feasible to extract the heat from the jacket water in the form of steam by circulating the discharge through a vessel in which a pressure is maintained lower than the steam tension corresponding to final jacket-water temperatures. The water, in passing through the low-temperature boiler, will be partly evaporated until the whole body is chilled to the low temperature. There would even be a tendency for this action to take place violently in the boiler. This can be obviated by a proper design in which the water passing through is divided into sheets, or sprays, so that steam may be released with the minimum amount of resistance.

In ordinary practice, the jacket- and piston-water temperature averages about 150 degrees. Allowing a working range of 20 degrees for the jacket water, secondary steam may be supplied to the final turbine stages or rows, at 130 degrees. Between 130 degrees (4½ pounds absolute) and 102 degrees (28 inches vacuum), the ideal water rate is approximately 50 pounds, and with a Rankine cycle efficiency of practically 65 per cent. in the lower last row of blades, the actual water rate becomes 77 pounds per brake horsepower-hour. With 33 per cent. of the heat being absorbed by the jackets, 3300 B.t.u. become available when the engine is at full load; 1018.7 B.t.u. are required to evaporate one pound of steam from and at 130 degrees and hence $\frac{3300}{1018.7} = 3.24$ pounds of steam available per engine brake horsepower-hour at 4½ pounds absolute pressure. This is then equivalent to producing $\frac{3.24}{77} = 4.21$ per cent.* of the gas-engine output, which, added to the power from the exhaust heat, amounts to 12.75 per cent. In the smaller plants, this may not be greater than 11.75 per cent. Evidently these quantities represent the gross gain by

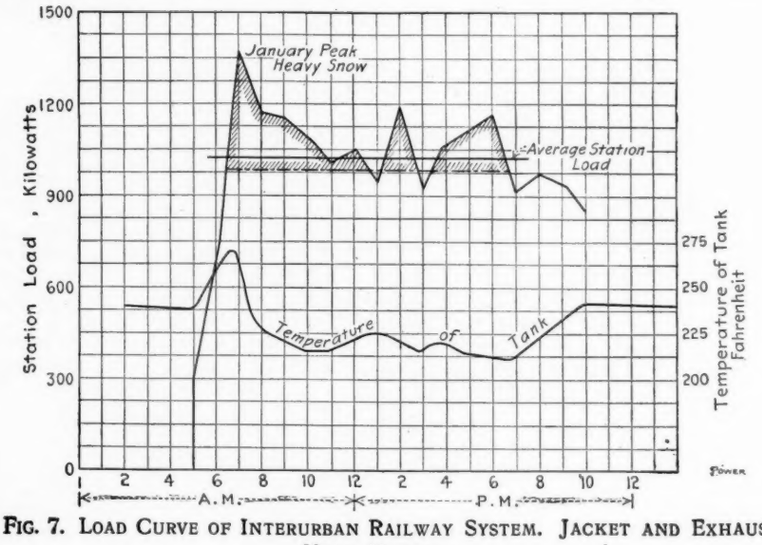


Fig. 7. Load Curve of Interurban Railway System. Jacket and Exhaust Heat Utilized

*Temperatures of 150 degrees Fahrenheit have been considered for the jacket and piston water. Should the temperature be raised to 200 degrees Fahrenheit as found in some foreign plants, the power that may be developed from the jacket heat would be doubled. The advantage will probably inspire this practice.

the operation of a low-pressure turbine; and to determine the net benefit that may be obtained, the power consumption of the auxiliary condenser and pumps must be deducted. As a close approximation, it may be assumed to be 1 per cent. for every 6 pounds of steam consumption of the main unit; in other words, 2½ per

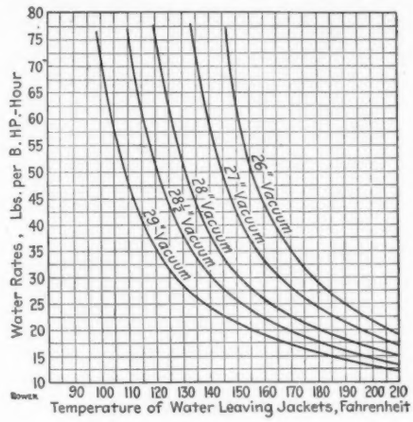


FIG. 8. IDEAL WATER RATES

cent. for 15 pounds steam consumption per brake horsepower-hour, 5 per cent. for 30 pounds, 12½ per cent. for 75 pounds, etc.

Furthermore, a small allowance must be included for radiation and friction, say 2 per cent. The following establishes a fair estimate of the true improvement:

$$8.54 \times (1 - 0.04) \times 0.98 = 8.04\%$$
$$4.21 \times (1 - 0.1283) \times 0.98 = 3.595\%$$
$$11.635\%$$

The smaller plant would, in proportion, be about 10.5 per cent. The coal consumption of the plant would be lowered 10½ to 11½ per cent. by the installation of the low-pressure turbine using both exhaust and jacket water. If operating only on exhaust heat, the reduction would be but 7 to 7¾ per cent.

For the purpose of designation, the steam obtained from the exhaust-gas heat, being predominant in available energy, may be correctly termed the "primary" steam, and that obtained from jackets the "secondary" steam. While the percentages expressed above were for full-load conditions, they may be safely applied, to an extent, to fractional loads, it being noted that the engine declines in efficiency at somewhat greater rate than the turbine and auxiliaries, and thus a fairly uniform percentage should obtain over a wide range in load.

In addition to the saving above shown, the sensible heat of the gas leaving the producer may be absorbed in an economizer placed between the producer and the scrubber, and the steam thus generated consumed in the low-pressure turbine. This item has been neglected, however, as it represents but a small percentage of the heat which may be conserved, and as a producer with an integral vaporizer has been considered, this extra apparatus seems unwarranted.

Some brief data on turbines and exhaust boilers may be appropriate for reference.

DISTRIBUTION OF HEAT AT AVERAGE LOAD

The characteristic performance of the gas engine is exemplified in the Norton tests which form a part of volume No. 29 of the American Society of Mechanical Engineers *Proceedings*. Based on brake-horsepower output, the items divide as follows:

Useful work	24.90
Electrical losses	....
Friction and pump work	4.58
Jacket absorption	34.22
Exhaust and radiation* (by balance)	36.30
Loss in producer	....

TURBINES

Results of series of tests under conditions of varying vacuum, conducted two years ago on one of the first double-flow, reaction, low-pressure turbines, are presented in Fig. 9. While it is to be understood that they are not typical of the improved economies secured with later designs, they are very complete and are to be found instructive in this study.

The efficiency obtained then was 65 per cent. on a 2000-brake horsepower turbine. A like efficiency is probable in a turbine such as that discussed in this paper.

In some research work undertaken by The Westinghouse Machine Company, a low-pressure turbine designed for an initial pressure of 2½ pounds absolute and 1 pound absolute back pressure, produced the results plotted in Fig. 10. The experience that was gained from the operation of this very small machine justifies the assumption made above for the large units, which would also benefit from more recent knowledge of the requirements.

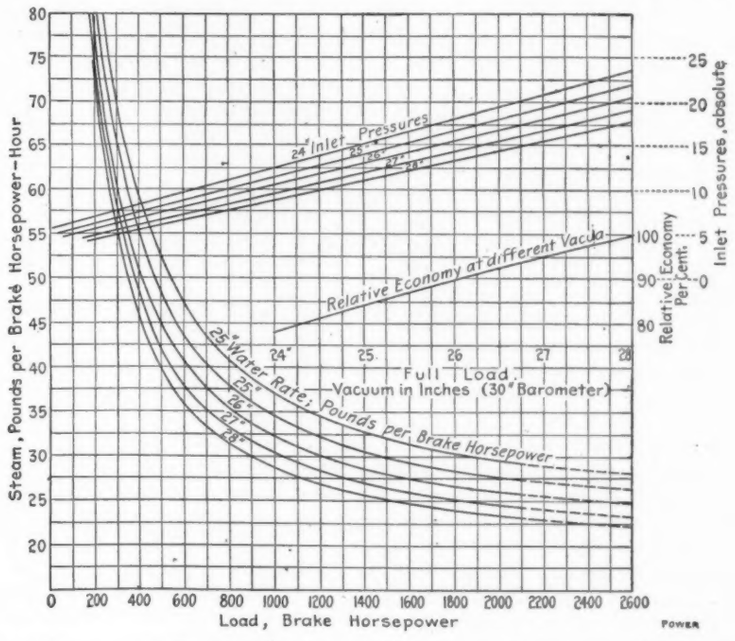


FIG. 9. RESULTS OF ECONOMY TEST OF 2000 BRAKE HORSEPOWER LOW-PRESSURE TURBINE

EXHAUST BOILER

A countercurrent, cast-iron exhaust boiler under test exhibited the amount of steam that could be practically generated from the engine exhaust. Fig. 11 shows that, regardless of rating, 20 per cent. of the heat input to the engine may be converted into steam.

It is important that the exhaust heater be placed close to the engines to reduce the length of the exhaust piping, and consequently the radiating surface. As it is impracticable to lag the exhaust piping with nonconducting material, owing to the heating and trouble at the engine that would result, it becomes desirable to water-jacket this piping, either as shown in Figs. 1 and 2, with special cast pipe or perhaps with a less expensive method of small coils wrapped around the pipe. The primary steam mains pass through the exhaust header, which secures a small superheating effect.

LOW-TEMPERATURE BOILER

Recovering heat from the jacket water in the form of steam is almost ideally accomplished. The apparatus consists merely of an elevated cylinder, shown in Fig. 2, through which the jacket water is allowed to flow. Water entering the drum or cylinder will be approximately at the temperature at which it leaves the engine jackets. It is then only necessary that a pressure be maintained in the chamber corresponding to the temperature of the water leaving the boiler, and that the water travel at a sufficiently low rate to

*Radiation, which is included with the exhaust by balance, should be omitted for computing the available heat for steaming.

allow proper disengagement of the steam. The boiler is elevated to avoid operating the jackets and water lines under vacuum and to prevent the formation of steam pockets which otherwise would be liable to be injurious to the cylinders. Regardless of the fact that all the heat is transferred from the jacket to the steam, the boiler cannot be considered 100 per cent. efficient. To effect the interchange, the temperature must be lowered, which reduces the available energy in the steam. Thus its efficiency may be only from 60 to 80 per cent.

Storage Tanks and Insulation

Guide or baffle plates may be used in the tank to facilitate circulation, which will manifestly depend upon the rate at which the energy may be withdrawn from the tank.

Owing to the large tanks that are essential, it is advisable to maintain the working temperature and pressure above atmosphere. This obviates the expense of providing tanks to resist the collapsing tendency under a vacuum and prevents air leakage. On the other hand, while it is desirable to have as high a temperature elevation as practical to confine the heat storage to a small body of water, there are obviously natural limitations in the exhaust heater. Present calculations show that from 45 pounds absolute (274 degrees) to 15 pounds absolute (a range of about 64 degrees Fahrenheit) best suits the conditions. The amount of water necessary to absorb the heat available from the gas engine is a definite quantity, depending upon the temperature range worked through and the time during which the heat is supplied; in other words, the hours of engine operation preceding the peak load.

The curves, Fig. 3, have all been plotted on the basis of 64 degrees Fahrenheit temperature drop, and it therefore follows that the curves of constant period of engine operation preceding the peaks are also lines of constant tank volume. Thus for a period of four hours engine operation at full load previous to the peak, 2.5 cubic feet per kilowatt of gas-engine capacity are necessary; for 6 hours, 3.75 cubic feet; 8 hours, 5 cubic feet, etc. For a 2000-kilowatt plant, this corresponds to a tank volume of 5000 cubic feet. If the peak is to last three-quarters of an hour after four hours storage, 840 kilowatts, or 42 per cent. of 2000 kilowatts, are available from the low-pressure turbine. Proportioning the tank allows considerable latitude. The area of the surface of the water, or disengagement of the steam, may be determined by employing a disengaging velocity of the steam varying from 1½ to 5 feet per second. Thus the dimensions of the tank may be accommodated in a large measure to the plant layout. The tank should be equipped with burners or grates and fire tubes, at relatively low cost, such that a byproduct plant could be made self-contained in an emergency.

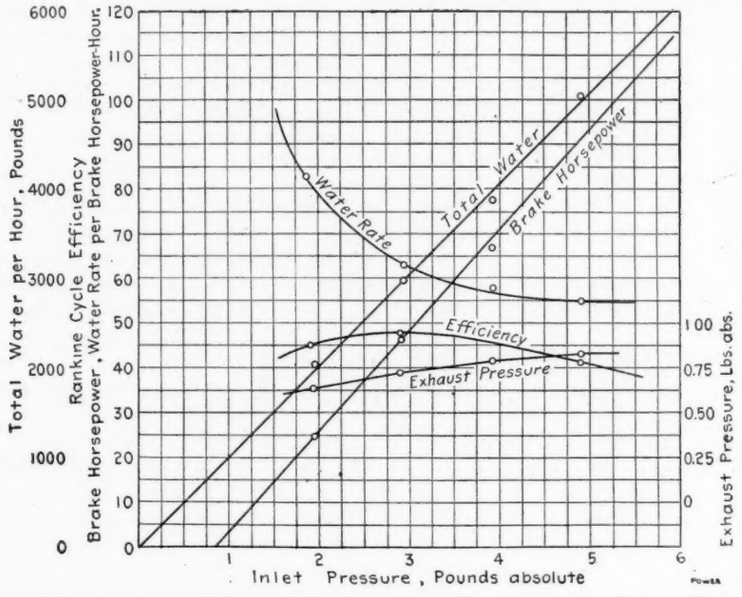


Fig. 10. Results from Test of 20-horsepower Low-pressure Steam Turbine

Losses from radiation and conduction may be made very small items. Low temperatures are used, and consequently the rate of transfer, depending upon the temperature difference, will be correspondingly low.

Radiation loss from the heat-storage system is an extremely low percentage of the low-pressure power available. Authorities on the subject of "Conduction and Transmission of Heat" differ somewhat in opinion as to the rate of heat dissipation from cast-iron and sheet-steel surfaces; 2.5 B.t.u. per hour per degree difference in temperature per square foot of bare surface is about the accepted average.* With 85 per cent. covering efficiency, the actual loss per square foot is 0.375, or ⅜ of a B.t.u. With approximately 180 degrees average temperature difference, the hourly loss per square foot would be 67.5 B.t.u. As 37,500 B.t.u. are, roughly, required to develop a kilowatt-hour in a low-pressure turbine,

$$37{,}500 \div 67.5 = 556$$

square feet of exposed surface would

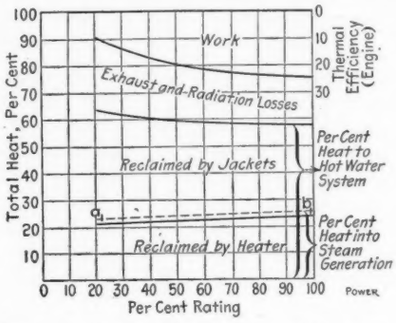


Fig. 11. Heat Balance from Test of 200-horsepower Gas Engine and Heater with 134 Square Feet of Heating Surface

represent a loss of one kilowatt in an hour. In case of the 2000-kilowatt plant results, a tank 15 feet in hight and 28 feet in length, would be required, providing 20 per cent. steam space. Together with the connecting pipe, the radiating area would be in the neighborhood of 2500 square feet and the loss per hour would be

$$2500 \div 556 = 4.5$$

kilowatts. For four hours operation preceding the one-half hour peak of 840 kilowatt,

$$4.5 \times 4 = 18$$

kilowatts would be lost. This amounts to only $\frac{18}{840}$, 2.15 per cent. of the power required. These radiation losses have been more than conservatively covered in the accompanying results.

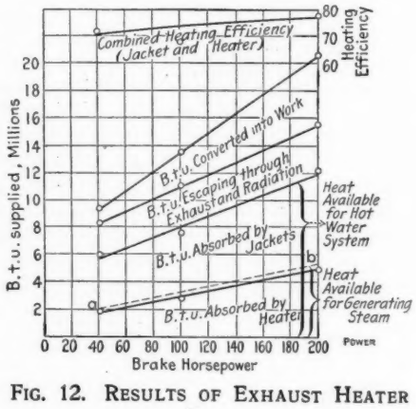


Fig. 12. Results of Exhaust Heater Test

Addendum on Heating Systems

The utilization of gas-engine waste heat was attempted very soon after the gas engine assumed commercial importance, over twenty-five years ago, effort

*Steam-heating engineers use a lower value.

being applied to divert as much of this heat for steaming and industrial purposes as possible.

The amount of heat to be obtained in the form of steam or hot water is given in Figs. 11 and 12. Two facts have operated against a more general adoption of gas-engine waste-heat systems. First, the steel boilers that were employed at the outset were very seriously corroded by the sulphurous-acid gas and the moisture present at the low temperatures. The introduction of cast-iron heaters should revive the use of waste gases. Only 1¼ per cent. of the jacket water* may be evaporated by the exhaust heat, and the use of the jacket water in a hot-water system involves several disadvantages, and more complicated and costly installation. Secondly, where the ratio of heating requirements to the power demanded in isolated industries or buildings is large, the noncondensing steam motor is obviously superior. Probably in a southern latitude, or where the power consumption is large in comparison with the heating to be done, sufficient heat may be obtained from the gas engine.

*3300 ÷ 20 = 165 pounds jacket water per brake horsepower-hour.

ACKNOWLEDGEMENTS

The author is indebted to the Westinghouse Machine Company for permission to use these data, and to A. T. Kasley for fruitful suggestions in the arrangement of details of the installation.

Safety Valves and Their Application

By John S. Leese

The limitations and uses of the different types of safety valves and the necessary computations for setting one of the ball and lever type.

All steam boilers should be fitted with two safety valves, one of these valves to blow off for high steam pressure, and the other for both high steam pressure and low water. The former is generally of the dead-weight or direct spring-loaded type. Where springs and weighted levers are used, the lever and the weight should be such that the valve will open at blowing-off pressure when the weight is at the extreme end of the lever. This prevents overloading, due to slipping of the weight, although unscrupulous attendants may adopt the dangerous and often criminal practice of hanging more weights on the lever. There are other points to be noted in connection with the choice of a lever-type safety valve; for instance, if guide forks are fitted to the lever, they must be open at the top so that the lever cannot become wedged; also, iron to iron contact should not be permitted for the lever pins on account of rust. If the valve is of the closed type the "iron to iron" remark applies also to the valve spindle passing through the cover. Dead-weight valves are not permissible on marine, portable or locomotive boilers, owing to the vibration and swaying, but the direct spring-loaded type is not affected in this way.

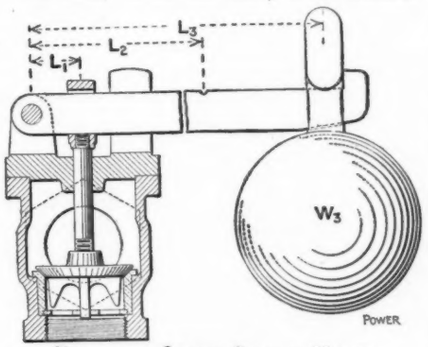
The second safety valve is often connected to a float in such a way that it will open when the water sinks to a certain level; this type is known as the "low-water safety valve." Preferably it should open for high steam pressure as well.

On many portable boilers, especially those that have been in service for many years, lever safety valves, loaded by spring balances, are used. It should be made impossible to lock these by screwing up the thumb nut on the balance, as an unskilled attendant may ignorantly cause disastrous results. The readings on the spring-balance scale should indicate "pounds per square inch" by a suitable proportioning of the valve area and the length of the lever to the pressures. Neglect of these precautions has led to many explosions, owing to the attendant being ignorant of the existing pressure.

Where the use of dead-weight safety valves is prohibited, there appears to be no reason why direct spring-loaded valves should not be used. They are much preferable to the lever-spring-balance type.

Safety valves should never have a diameter less than two inches, the relation of diameter to lift being a much debated point. In the writer's opinion neither extreme, that is, high lift and small diameter or small lift and large diameter, is desirable, but rather a mean might be reached between the two.

In many cases the valve is so formed



BALL AND LEVER SAFETY VALVE

that the reaction of the steam blowing through it increases the lift, thus insuring the full area of opening. The use of a lifting gear arranged so that the safety valves may be operated by hand from the floor of the engine or boiler room, may be decidedly advantageous in cases of emergency.

Referring to the sketch, let

W_1 = Weight of valve;
W_2 = Weight of lever;
W_3 = Weight on end of lever;
L_1 = Distance from fulcrum pin to center of valve;
L_2 = Distance from fulcrum pin to center of gravity of the lever;
L_3 = Distance from fulcrum pin to center of weight;
A = Area of safety valve, in square inches;
P = Steam pressure at which valve will blow off, in pounds per square inch.

Then,

$$P \times A \times L_1 = W_1 \times L_1 + W_2 \times L_2 + W_3 \times L_3$$

and,

$$P = \frac{W_1 \times L_1 + W_2 \times L_2 + W_3 \times L_3}{A \times L_1}$$

The miter of a safety valve should not exceed one inch.

Electrical Engineering Exhibition

The third triennial exhibition of electrical engineering and machinery is to be held at Olympia, London, this year, from September 23 to October 21. It is to be international in character and is a manufacturers' exhibition, promoted by the large electrical manufacturers of England, through their association, the National Electrical Manufacturers' Association. All the exhibiting firms will participate in the profits, if any, arising from the exhibition, although their liability is limited to their space rental, which is advertised not to be in excess of those of any similar exhibition.

The forthcoming exhibition, it is stated, will be the largest event of the kind which has ever been held in England, and perhaps in any other country. The fact that this event will take place in the coronation year, it is urged, is also strongly in its favor, as there will be a large number of colonial buyers visiting in London, who will embrace the opportunity of visiting such an important undertaking, in which many of them will be keenly interested.

It is suggested that if any manufacturers of the United States contemplate participating in this exhibition, it is important that they make inquiry early as to space, because a large percentage of the ground floor and a very large proportion of the galleries have already been engaged.—*Daily Consular and Trade Reports.*

Friction Clutches and Their Use

By H. A. Jahnke

Reasons why the use of clutch pulleys and cutoff couplings makes for economy. Suggestions in regard to the selection of suitable clutches. General description of some clutches of well known make.

In most manufacturing plants changes and improvements are constantly being made in the machinery for the sake of effecting greater economy. But, strangely enough, in many plants, although they are equipped with modern machinery, there exist inefficient means of stopping and starting line and countershafting. Aside from the independent, electric-motor drive, there is nothing better for this purpose than the friction clutch. The use of clutches permits the shafting to be so divided that it is only necessary to run the machinery, countershaft and line shaft which are actually in use. Thus a machine, countershaft, line shaft or whole department may be shut down without interfering in any way with other departments or equipment. This results in a saving of power and time and should be appreciated by every engineer and

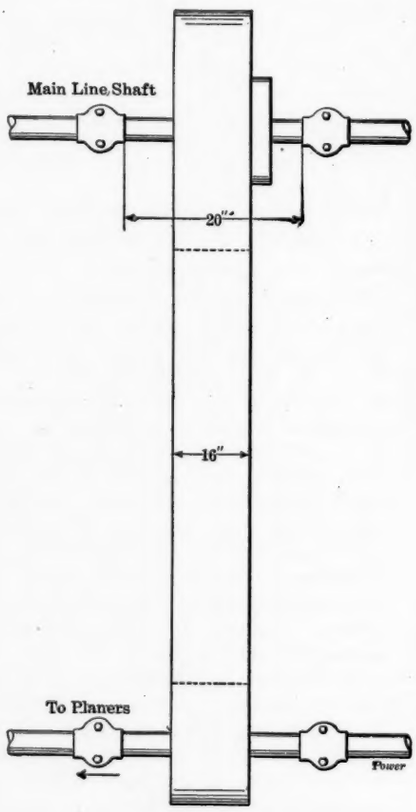


FIG. 1. USE OF FRICTION CLUTCH TO ECONOMIZE SPACE

power-plant owner who perhaps has seen a whole plant shut down, the men standing idle and production stopped, all due to the breaking of a belt, rope or pulley. Where friction clutches are in use this trouble can be overcome. Of course, to equip a whole power-transmission system with friction clutches is quite expensive, but it should prove to be cheaper and more efficient, in the long run, than the use of tight and loose pulleys. With friction clutches, the loads may be picked up slowly while the driving shaft is running at full speed. Further, clutches act as safety devices and eliminate strains upon machinery and belting. The slippage in starting and stopping is taken up by the clutch instead of the belt.

If it is desired to place friction clutches in line of shafting so as to make parts of the shaft independent units, this can easily be done by removing shaft couplings at convenient points and in their place putting friction-clutch cutoff couplings. By the use of a split type of friction-clutch cutoff coupling such a change can be made without much expense or trouble.

A large percentage of the unnecessary cost of running line shafts and countershafts can be saved by arranging the shafting and machinery so that parts can be stopped by means of friction clutches when not in use.

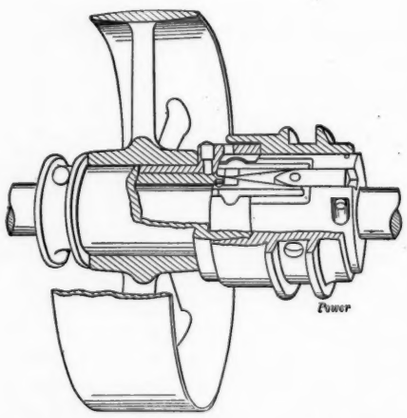


FIG. 2. JOHNSON CLUTCH, ENGAGED

Often, slight changes in transmission conditions save a great loss of time. Take, for example, the following case of a machine which is driven direct from the line shaft by means of a 4-inch belt. In order to start or stop this machine the belt has to be shifted from tight to loose pulley or *vice versa*. Should the belt tear or need tightening during the time when the machine is in operation, the line shaft has to be stopped before adjustment can be made. Often, this results in shutting down other departments. This would not be the case if there was a friction clutch on the line shaft; all that would be necessary would be to disengage the clutch and any repairs could be made without interfering with other parts of the transmission equipment. Friction clutches save wear and tear on the belts. With a tight- and loose-pulley arrangement, when the belt is shifted from one to the other, the stress in the edge of the belt is considerable. This results in the burning of the belt and the opening of the laps at the edges.

In a certain plant, a line shaft, used for driving planers, had been driven for many years by a 10-inch double leather

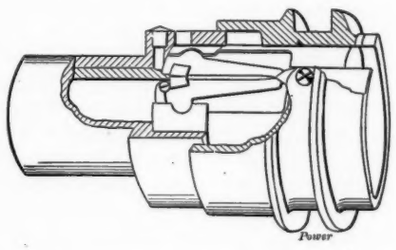


FIG. 3. JOHNSON CLUTCH DISENGAGED

belt from the main line shaft. The planer line shaft was arranged with a tight and loose pulley to permit the stopping of this shaft during the noon hour and at night when machinery in other parts of the factory was worked overtime. A few years ago it became necessary to install a larger belt to drive the planer line shaft, due to the installation of more machinery. A 16-inch belt was necessary. Had it been necessary to use the tight- and loose-pulley system with the larger belt, considerable work would have been required, for the new pulleys would have required 32 inches and this would have necessitated the shifting of the bearings. By the use of a clutch, however, this was obviated, as shown in Fig. 1.

For economy of space and convenience in subdividing transmission systems into separate parts, any of which may be taken out of service without disturbing the others, friction clutches find extensive use. It may be well, therefore, to consider the design and operation of some clutches in general use.

Clutches may be divided into two general types, the ring type and the disk type. In the former, the friction surfaces bear on a ring which is concentric with the shaft. In the latter, the surfaces bear on a disk which is normal to the shaft.

In most clutches one contact surface

is composed of wood while the other is made of cast iron. The advantages consequent to the use of these materials are: High coefficient of friction; uniform contact due to the wearing of the wood shoes; low cost of renewing wood shoes; negligible amount of wear of cast iron in contact with the wooden sur-

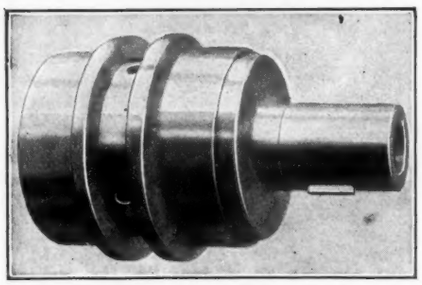


FIG. 4. EXTERIOR VIEW OF JOHNSON CLUTCH.

faces; the fact that wood can be used without lubrication, and freedom from danger of the surfaces seizing.

In purchasing a friction clutch great care should be taken to select the right size of clutch to transmit a given horsepower and due consideration should be given to the character of the work which is to be performed. Especially is this so if the clutch is to be used in connection with an electric motor. Where the motor is capable of carrying perhaps 50 per cent. or more overload that clutch should be selected which has a horsepower rating at least 50 per cent. in excess of that of the motor.

A clutch which is frequently thrown in and out will be subjected to more wear and tear than a clutch which is operated infrequently. A clutch will carry a uniform load more easily than a variable load. Greater satisfaction will be secured if a clutch is selected with a capacity in excess of the work required of it. Overloaded clutches are the source of much of the difficulty that users of friction clutches usually experience.

In placing a friction clutch on a line shaft it is advisable to put it as close to a bearing as is possible, because when the clutch is thrown in there is a heavy strain on the shaft. Friction-clutch pulley service, with its frequent stopping and starting, picking up and dropping a full load, is very hard on pulleys and it is advisable to use a substantial pulley for this service.

A friction clutch must receive good care if it is to do its work right. The bearings should be well lubricated and all friction surfaces kept free from dirt, oil and grease. Never allow a clutch to slip, for, ultimately, slipping will ruin a clutch.

THE JOHNSON CLUTCH

Figs. 2, 3, 4, 5 and 6 show the Johnson clutch. This clutch has few parts and is very compact. A body fastened to the shaft carries a split ring in which are inserted a pair of levers. A curved-shaped wedge which is made a part of the shipper sleeve, forces the levers apart, extending the ring and thus bringing its outer surface into frictional contact with the inner surface of the friction cup, the hub of which is made to suit requirements. The leverage is so compounded that it requires but slight pressure to operate the clutch.

This type of clutch is used in many plants in place of a countershaft for driving machines direct from the line shaft, as shown in Fig. 5, as they operate smoothly at any speed without bang or clatter and have no projections to catch anything. By using the double clutch, Fig. 5, on a countershaft with two pulleys, one carrying an open belt and the other a crossed belt, the machine can be run either in the forward or in the reverse direction. This form of clutch is especially convenient for running machines which require a reverse motion.

To adjust this clutch, all that is necessary is to give a single screw a fraction of a turn, or more if necessary, to

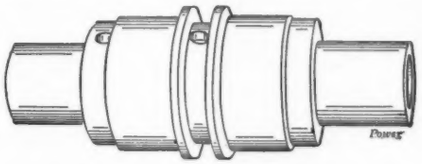


FIG. 5. JOHNSON DOUBLE CLUTCH

the right or left. This screw can be reached through the hole in the friction cup. The Johnson clutch is manufactured by the Carlyle Johnson Machine Company, Manchester, Conn.

THE HILLIARD CLUTCH

Figs. 7 and 8 show the Hilliard clutch. In this clutch all toggle mechanisms have been avoided, as will be seen in the part sectional view, Fig. 7. Two friction plates are drawn against a friction ring, which contains a number of hardwood inserts, by means of screws operated by spiral gears which are turned by the spiral racks attached to the sliding collar. Ball thrust bearings are provided for the spiral gears so as to reduce the effort necessary to engage the clutch. It will be seen that as long as there is space between the hub, or body, of the clutch and the sliding collar the clutch can always be thrown in tighter, and readjustment is not necessary until these parts come together.

This clutch is particularly valuable for controlling delicate machinery, especially

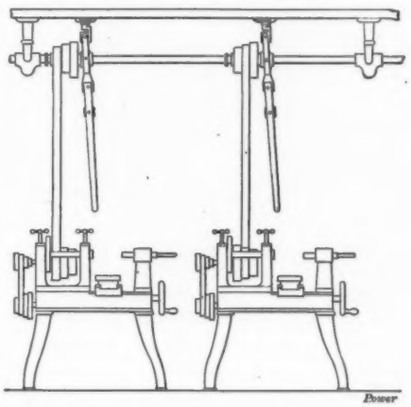


FIG. 6. DRIVING MACHINERY DIRECT FROM LINE SHAFT WITH JOHNSON CLUTCH

in textile mills where a sudden shock in starting may cause much damage, as the screws can be turned slowly, thus applying the friction gradually and picking up the load smoothly.

When the clutch needs adjustment this can be done by removing a nut which allows the sliding collar to be drawn out, taking the spiral racks out of mesh with the gears. By turning each gear the same number of teeth to the right the friction plates are drawn up the same amount on all sides. This clutch is especially free from bolts, nuts and fastenings and cannot easily get out of adjustment. The Hilliard Clutch and Machinery Company, Elmira, N. Y., manufactures this clutch.

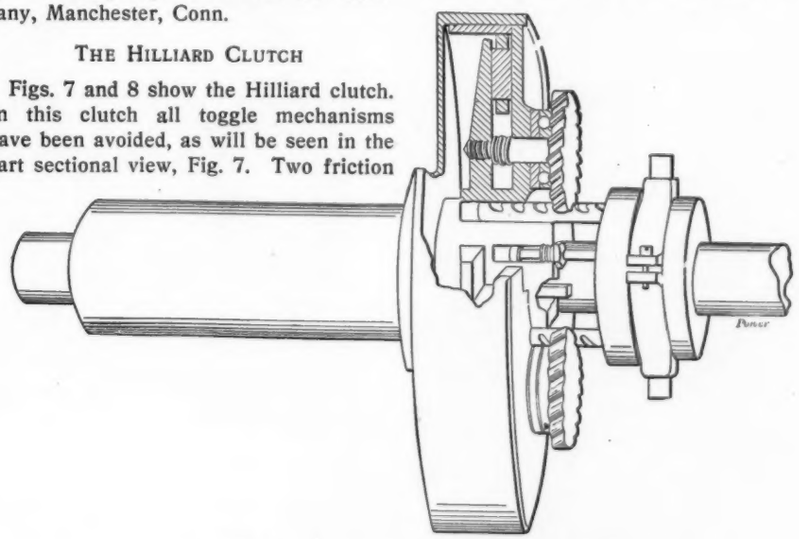


FIG. 7. PART SECTION OF HILLIARD CLUTCH

THE AKRON CLUTCH

In Figs. 9 and 10 is shown the Akro-

clutch, which is of the disk type. The construction of the Akron clutch is extremely simple, as a little study of the sectional view in Fig. 9 will show. The

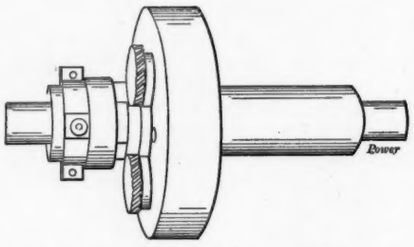


FIG. 8. OUTLINE OF HILLIARD CLUTCH

drum *A* carries a hub or sleeve to which a pulley, gear or sprocket wheel may be keyed. The head *T* of the drum is separate. Within the drum are arranged two cast-iron friction plates *C* which the keys *H*, sunk into the fixed, or driving, member *B*, force to rotate with the shaft. The disks *C* are free to move laterally on the keys *H*. The clutch depends for its power-transmitting capacity upon the friction between the disks *C* and the corresponding friction surfaces of the drum *A* and

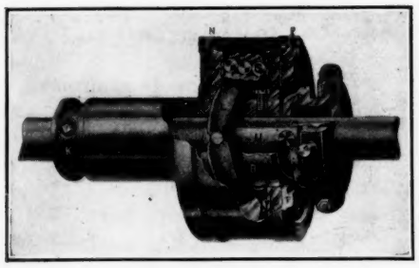


FIG. 9. SECTIONAL VIEW OF THE AKRON CLUTCH COUPLING

the cover *T*. The clutch is engaged by forcing apart the friction disks *C* into contact with the drum heads by means of the toggle mechanism, the latter being connected by steel links *U* to the sliding sleeve *E*. Regular shifter forks attached

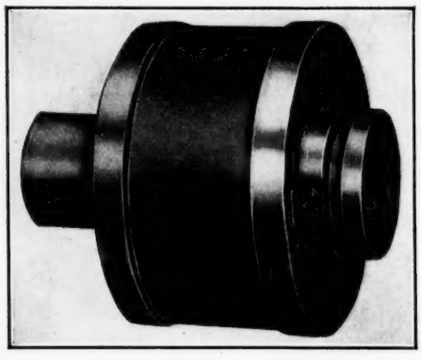


FIG. 10. EXTERIOR OF AKRON CLUTCH COUPLING

to the yoke *S* are used to disengage and engage the clutch. The roller toggle is a novel feature of this clutch; it consists of two forked liners *L* with chilled holes through them in which are lodged three hardened tool-steel rollers. When the levers *L* are perpendicular to the shaft, the center line of the three rollers is perpendicular to the faces of the friction disks, and the latter are pressed apart into contact with the friction surfaces. The design of the improved shifter ring *S* is such that the oil is retained while dust and dirt are excluded. The ring is made of cast iron and lined with babbitt.

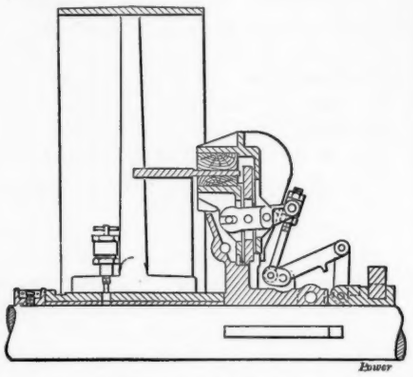


FIG. 11. SECTION OF ONE-HALF OF HILL "SMITH TYPE" CLUTCH

The Akron clutch requires no attention other than the occasional renewal of oil in the case through the oil hole *N*. The cover *T* serves to retain the oil.

The clutch is adjusted by means of the head *T* which is screwed into the drum *A* and provided with notches in

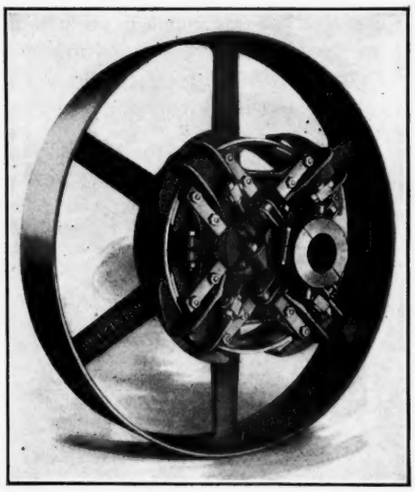


FIG. 12. HILL "SMITH TYPE" CLUTCH

which the point of the locking screw *P* engages. The pitch of the screw and number of the notches are so proportioned that one adjustment of one notch corresponds to a lateral movement of 1/200 of an inch between the friction surfaces. The Akron clutch is made by the Williams Foundry and Machine Company at Akron, O.

THE HILL "SMITH TYPE" CLUTCH

The new Hill "Smith type" friction clutch is shown in Figs. 11 and 12. In this clutch the positive release feature is new, and eliminates the use of springs formerly used for disengaging the fric-

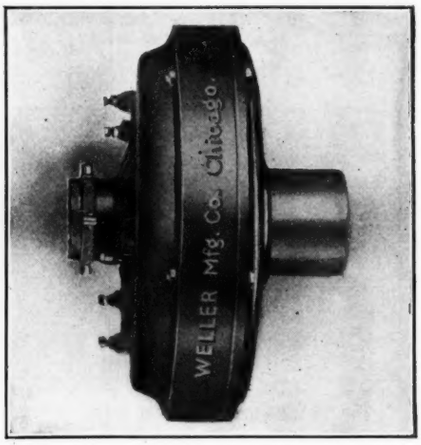


FIG. 13. THE WELLER COMPOUND CLUTCH

tion jaws. As an examination of Fig. 11 will serve to show, the continuous toggle connection from the cone to the jaws positively releases the ring when the clutch

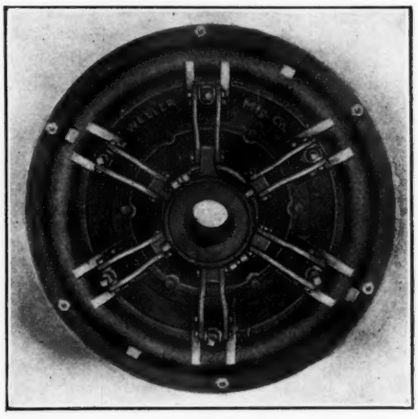


FIG. 14. SIDE VIEW OF WELLER COMPOUND CLUTCH

is thrown out. This new clutch is distinguished by improvements in the design which allow any working part to be removed parallel to the shaft from the

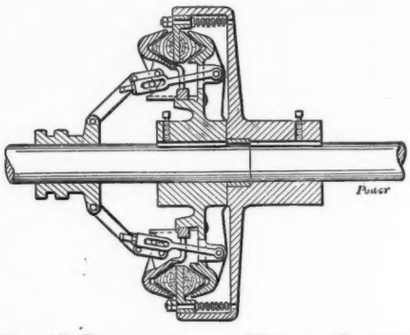


FIG. 15. DETAILS OF THE WELLER CLUTCH

mechanism side without removing the main spider casting. On account of the rigidity of the construction, the clutch is self-protective; if the clutch is loaded be-

yond the limit set by the jaw adjustment, slippage ensues instead of breakage.

This clutch is manufactured by the Hill Clutch Company, Cleveland, O.

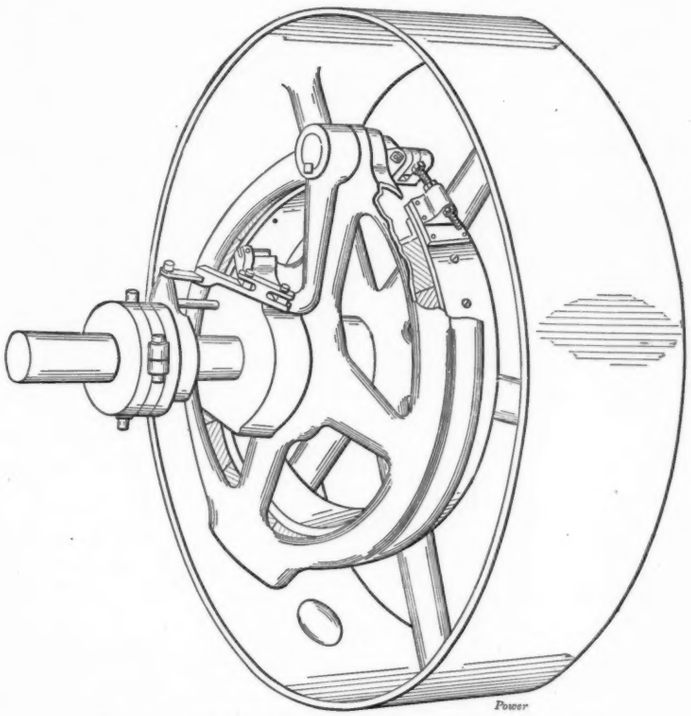


FIG. 16. CALDWELL CLUTCH ATTACHED TO PULLEY

THE WELLER COMPOUND CLUTCH

Figs. 13, 14 and 15 show the Weller compound clutch, designed for high speeds and large powers. The clutch is made with two sets of wedge- or V-shaped wooden shoes extending around its entire circumference. When used as a cutoff coupling, the V-shaped construction of the wooden shoes and iron friction ring or grips which engage the latter helps to keep the shaft in line. The ring or plate to which the wooden shoes are attached is dovetailed into the drum of the clutch and acts as a universal joint when the shafts are out of alinement.

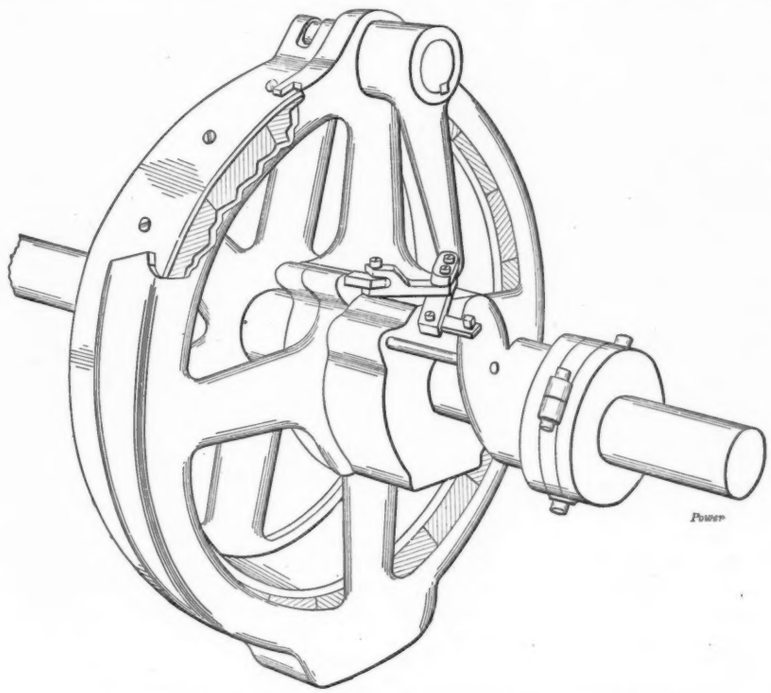


FIG. 17. CALDWELL FRICTION CLUTCH CUTOFF COUPLING

The Weller Manufacturing Company, Chicago, makes this clutch.

THE CALDWELL CLUTCH

The Caldwell clutch, shown in Figs. 16 and 17, can be attached to a pulley or used as a friction-clutch coupling. The principal features of the Caldwell clutch are large friction surface, simplicity and small number of parts. A steel friction band is lined with hardwood friction blocks and when the clutch is engaged contact is obtained entirely around the friction surface, distributing the strains equally on all parts of the friction mechanism.

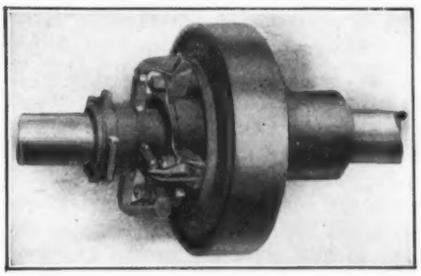


FIG. 18. UNIVERSAL GIANT FRICTION CLUTCH CUTOFF COUPLING

This clutch is manufactured by the W. E. Caldwell Company, Louisville, Ky.

THE UNIVERSAL GIANT CLUTCH

Figs. 18 and 19 show the Universal Giant clutch. This clutch is of compact design, strongly built, easy to apply and readily adjusted. It is designed so that the outer rim covers and protects the friction disks from dust and dirt. The friction surfaces, which have a large area, are wood and iron. Selected hardwood blocks are filled into the friction disk so as to present two end-grain surfaces which come in contact with the two iron surfaces of the friction plates when thrown into or out of engagement. The friction disk and follower plates adjust themselves with the clutch.

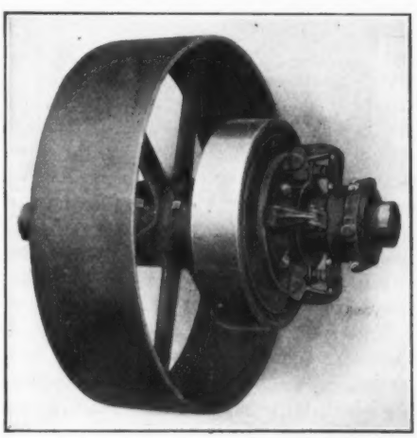


FIG. 19. UNIVERSAL GIANT CLUTCH ATTACHED TO PULLEY

The Universal Giant clutch is made by the T. B. Wood's Sons Company, Chambersburg, Penn.

Other clutches will be described in an early issue.

Underground Pipe Covering

By Charles H. Herter

The modern tendency to distribute heat from central points makes it necessary to lay steam pipes underground more frequently than ever; consequently, information on this subject should be appreciated by those who are expected to do underground pipe work in an uptodate manner and at moderate cost.

The essential features of a successful underground conduit conveying steam, hot water, cold brine, ammonia, etc., are now recognized to be perfect insulation and protection. These can only be obtained when the outside of the pipe is always dry. The importance of dryness is only realized fully when it is remembered that the transmission of heat from a steam pipe to surrounding quiet air is from 2.1 to 2.8 B.t.u. per degree Fahrenheit temperature difference per square foot of pipe surface per hour and that proportionately greater losses result when the best possible conditions are not maintained.

Any type of wooden inclosure is subject to decay, sooner or later, and should, therefore, be avoided, for there is available now material which is proof against water, fire, acid and time. A conduit which has been used in many important installations within the past fifteen years is one which is specially prepared for underground service. It is made from stoneware and fireclay, passed through hydraulic presses, vitrified and glazed inside and out. This pipe in form is similar to ordinary bell and spigot sewer pipe, except that, after burning in the kiln, it is split into duplicate numbered halves, for which purpose two downward diagonal grooves are cut along the interior wall, leaving at least one-half of the thickness rough for cementing. Care is taken to cement the same halves together on the job as when mending a broken plate. The conduit comes in 3-foot lengths and in diameters ranging from 6 to 30 inches. There should always be a distance of not less than 3 inches between the wall of the conduit and the nearest steam pipe. One or more and different sized pipes can be inclosed in the same conduit.

About every 15 feet a special supporting tee with the branch set downward and inclosing pipe supports concreted in this base is provided. These supports are provided with rollers, permitting the pipes to expand and contract freely without imposing the least strain upon the conduit. Clamps with anchor bolts embedded in concrete in a blind pit or a manhole are used for anchoring the steam pipes at suitable points, especially where the direction or elevation of the line changes. Expansion is provided for by expansion joints, arranged in water-tight manholes at proper intervals. Where the line enters a building or a manhole, or inside building walls, a shutter is built of 4 inches of concrete on lattice work spread over the opening of the conduit to prevent the passage of vermin from one building to another, and to seal the conduit. Sleeves of suitable pipe covering about a foot long and wired with a waterproof jacket or of the next larger size pipe, are put on each pipe to act as a stuffing box allowing pipes to slide without injury.

For brine and ammonia pipes the conduit can be packed with fine, regranulated cork, say 8 pounds for each cubic foot of space filled. For steam, hot-water pipes, etc., H. W. Johns-Manville Asbesto-Sponge filling has proved to be very efficient, 7½ pounds being required per cubic foot. Its insulating value is exceptionally high and the material does not deteriorate under the heat and moisture met with in practice.

The approved method of laying this conduit is to dig a trench about 20 inches wider than the conduit and of proper depth and grade. As in any first-class work, it is essential to first of all lay an underdrain of sewer pipe in a narrow subtrench, the joints being laid open and not cemented. This underdrain, which is surrounded with broken stone, serves to lead away any water which might otherwise remain in contact with the conduit, absorbing heat much faster than dry material would. Connection to this underdrain can be made with the manhole pits, draining them of any drippings from valves or expansion joints. A clean gravel should ultimately extend up above the side joint of the conduit. Next, the lower halves of the various tile sections, unions and supporting tees, are assembled and cemented, and roll frames to carry the pipes concreted into bases of supporting tees. An opportunity is now presented to thoroughly test the whole pipe line for leaks, after which the upper halves of all conduit sections are cemented exactly in place, one by one, and packed with insulating material. Then the hub joints of the top halves are cemented up.

This type of conduit has been tested in the field by George H. Barrus and others, and found in the case of steam pipes to reduce the loss of heat to the extent of from 89 to over 94 per cent. of that suffered with bare dry pipe. Very few pipe coverings approach and retain this high insulating quality. The cost is little more than for wooden covering and much less than for a pipe tunnel.

Test of Zoelly Turbines

The accompanying table, taken from a recent issue of the *Zeitschrift für das Gesamte Turbinenwesen,* shows the results of a series of tests at different loads on four turbines of the Zoelly type, built by the firm of Escher, Wyss & Co., of Zurich. These turbines are extremely short and show especially good results.

TEST OF NEW ZOELLY TURBINE.

Rating of Turbine.	Kilowatts Developed.	Admission Steam. Gage Pressure.	Admission Steam. Temperature, Degrees Fahrenheit.	Vacuum, Inches.	Steam Consumption, Pounds per Hour per Effective. Kilowatt.	Steam Consumption, Pounds per Hour per Effective. Horsepower.	Thermodynamic Efficiency, Per Cent.
4000 kw.	4189	165	556	28.75	13.3	9.25	68.7
	3092	169	557	28.85	13.82	9.50	66.2
	2199	162	518	29.20	14.55	9.71	63.2
	1138	167	520	29.35	16.15	10.00	59.9
2000 kw.	2052	180	586	28.4	13.05	9.10	70.5
	1514	182	563	28.6	13.75	9.40	67.2
	1026	178	566	28.75	14.55	9.67	65.2
	510	172	544	29.00	17.40	10.58	58.8
1700 kw.	1641	206	669	28.00	13.10	8.8	69.7
	1366	203	672	28.20	13.80	9.10	66.5
	851	206	842	28.60	15.55	9.70	61
	457	209	642	28.40	18.95	10.52	57.1
1200 kw.	1235	163	450	28.40	15.40	10.62	67
	949	165	460	28.6	16.05	10.95	62.8
	606	167	424	29.00	17.15	11.35	59

Central Station Will Have to Show 'Em

No. 2, of Missouri, National Association of Stationary Engineers, St. Louis, is sending out to its members a very complete power-plant report blank. This is being done to encourage the engineers to keep a system of records.

The report is a four-page leaflet. On the first page, blank forms are to be filled which call for power-plant investment, total output, capacity of plant, cost per kilowatt-hour, total costs and credits for each month of the year, and other data of a leading character.

The second and third pages are devoted to daily, weekly and monthly costs, including fixed charges, wages, materials, repairs, service of plant, service outside of plant, lamps furnished and credit and bills under control. The fourth page is the daily log.

The report is one of the most completed of its kind that has come under our inspection, and if given the attention it deserves, the members will be better engineers and in addition they will have data that should forestall any encroachment of the central station.

Methods of Testing Boiler Steel

By Guy Wise

A description of the machine used in testing specimens of boiler plate with directions for preparing the test piece and conducting the test.

The formula for calculating the safe working pressure of a steam boiler is

$$\text{Safe working pressure} = \frac{\left(\begin{matrix}\text{Ultimate}\\ \text{tensile}\\ \text{strength}\end{matrix}\right) \times \left(\begin{matrix}\text{thickness}\\ \text{of plate}\end{matrix}\right) \times \left(\begin{matrix}\text{efficiency}\\ \text{of joint}\end{matrix}\right)}{\text{Radius of boiler} \times \text{factor of safety}}$$

Before this formula can be used, however, it is necessary to know what value to assign as the ultimate tensile strength of the plate.

It is almost universal practice for large users of steel plate to inspect and test all material bought, in order to make sure that it conforms to the specifications; also, this information, in connection with the results given by the material in actual service, is of great value in determining the requisites that are essential to good service so that these qualities may be specified and secured in future orders. Furthermore, it is common practice for the manufacturers of steel plate to make tests of samples of their entire output so as to know at all times the qualities of their product.

The machine generally used in this work is shown in Figs. 1 and 2. The specimen to be tested is represented by *A*, one end of which is held by the jaws in the upper or fixed head *B*, while the other end is similarly gripped in the lower or movable head *C*. The load is applied to the specimen by the downward movement of the head *C*, at the rate of about one inch per minute, trains of gears being used to drive the screws which draw the head downward. The load to which the specimen is subjected is sustained by the head *B* which, in turn, transfers it through the columns *D D* to the weighing table *E*. Inserted in the lugs on the lower side of the weighing table are hardened-steel pins which rest on the hardened-steel knife-edges of the main weighing levers *F*, which are fulcrumed on the base of the machine. The load is transmitted through the intermediate lever *J* to the graduated weighing beam *G* which carries the screw-driven poise *H*.

The specimens to be tested are sheared from the plate, trimmed to the overall size and then milled to the standard form shown in Fig. 3. Taking one of the specimens thus prepared, two punch marks are placed on it 8 inches apart, the width and thickness are carefully measured and the readings recorded, after which it is placed in the grips of the testing machine. The machine is started and the observer then operates the poise so that the weighing beam is kept floating; it is necessary to maintain this condition in order that the load on the specimen at any instant may be known. For a short time the load rises rapidly until a point is reached at which the beam drops suddenly. Noting the load on the beam at this point and recording it as the elastic limit, the test is continued, generally at a higher speed, and the beam maintained in the floating position as before.

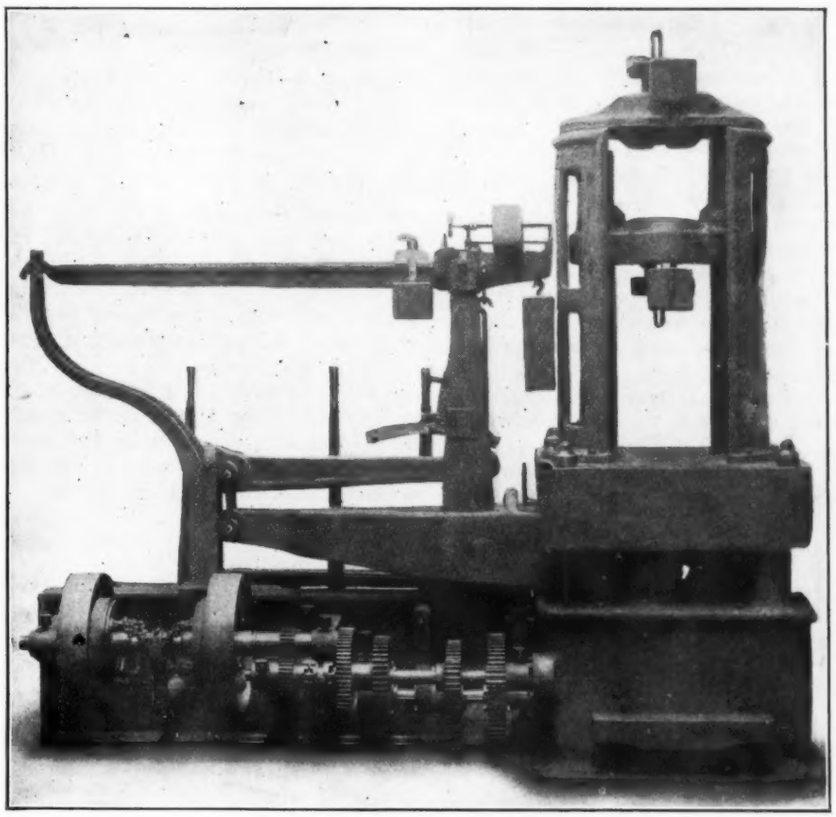


FIG. 1. TESTING MACHINE SHOWING DRIVING GEARS

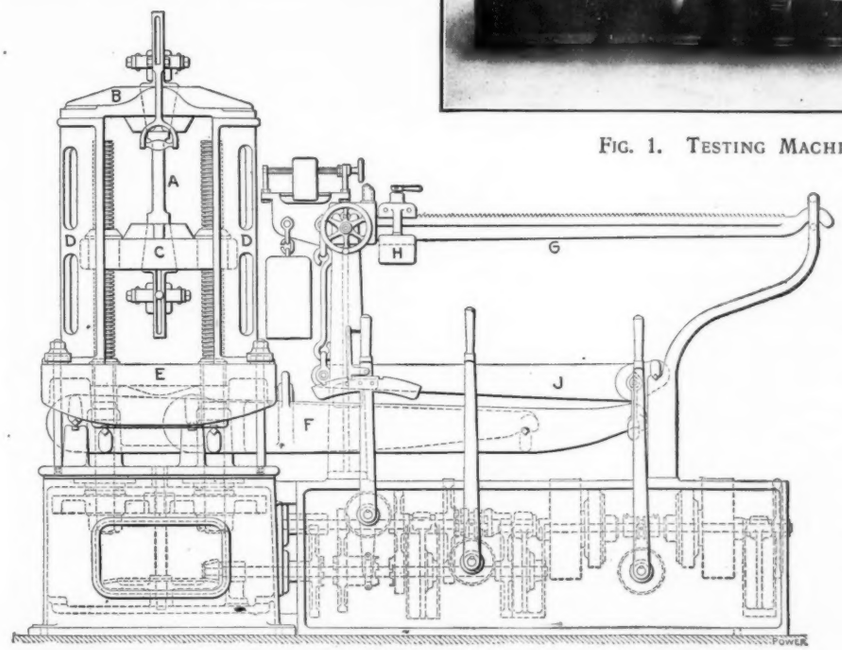


FIG. 2. SKETCH OF TESTING MACHINE WITH TEST PIECE IN PLACE

After passing the elastic limit the load increases steadily but slowly, even with an increase of speed, until the maximum load that the specimen can sustain is reached, when the beam drops and remains down. The load indicated on the beam at this point is recorded as the ultimate tensile strength. Also, the test piece is seen to be growing thinner at the place where rupture later occurs. From now on until the specimen breaks it is necessary to run the poise of the weighing beam backward if it is desired to keep the beam floating; this is practically never done as load readings beyond the maximum are not desired.

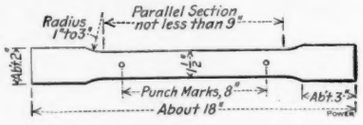


FIG. 3. STANDARD SIZE OF TEST PIECE

Immediately after rupture has taken place the machine is stopped and the specimen is removed. The shape of the fracture and the character of the steel are carefully examined and noted. The pieces are fitted together in their original position and the distance between the punch marks is measured. This dimension shows how much the specimen has been stretched.

Assume, for instance, the data taken during the test to be as follows: Final size, 1.48x0.52 inches; final area, 0.77 square inch; elastic limit, 25,680 pounds; ultimate strength, 46,820 pounds; elongation in 8 inches, 2.32 inches.

In order to be able to compare the results derived from the tensile tests of

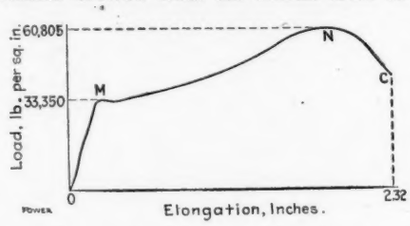


FIG. 4. CHARACTERISTIC CURVE

specimens of different thicknesses and widths, the data must be reduced in each case to the same basis. The necessary calculations are made so as to show the elastic limit in pounds per square inch of original area, the ultimate strength in pounds per square inch of original area and the percentage of elongation in 8 inches. Therefore, the final results of the test are recorded as: Elastic limit, 33,350 pounds per square inch; ultimate strength, 60,805 pounds per square inch; elongation, 29 per cent.

During the test, as described, no attention is paid to the elongation of the specimen other than to measure the distance between the punch marks after rupture. If, however, a number of readings of the elongation are taken and these results are plotted in connection with the loads which produced them, a characteristic curve similar to that shown in Fig. 4 will result. This diagram shows plainly the rapid increase in load for the small elongation which takes place up to the time the elastic limit at *M* is reached; here the load is seen to remain stationary for a time and then increase slowly while the specimen is stretching rapidly. This condition continues until the point *N*, representing the ultimate tensile strength, is reached, after which the load decreases, the specimen now stretching rapidly until rupture occurs at *O*.

The ultimate tensile strength of boiler steel varies from 55,000 to 65,000 pounds per square inch so that in the calculation for the safe working pressure of a boiler the average value of 60,000 pounds per square inch is generally used.

Writing for the Technical Paper

BY E. DIXON

Havin' ben afflict'd with "writer's itch," almost since berth, sum pain, plesure an' profit hav' kum mi way from usin' a pencil. Mi furst experience, wuz with mi mother, after I'd dek'erat'd a newly paper'd wall with a few chaste records of mi thoughts. She chas'd me an caught me an I need'd a cushin real bad for the next few days. Gee, but she stung me proper. When I went to the skool, the teacher an' I got in wrong with each other an I us'd the blackboard to express my opinion. The illustrations were rather raw but I had a fair opinion of the writin' until the teacher convinced me that it was impolite.

When I got into the shop, I commenced to fin' out where a lot of the "dope" I'd side stepped wuz useful. Well, there were induc'ments. I saw the foreman knew more nor I did an' wuz not a hull lot delited to supply informashun. It didn't seem squar' to me an' I kep' mi eyes wide opun a lookin' fur things. One day I caught on to the fac' that the way Jim figgered out the change gears fur a screw I wuz to cut had a sorter familiar look, an' that nite to hum I dug up mi rithmetic. I found a part of it call'd "proportion" an' I set down to study it out. I'd made a list of the change gears fur the lathe an' the number of threads in the lead screw an' the number of teeth on the spindle gear. I dugged 'till I got the thing strait in mi noddle an' the nex' time I had a thread to cut I made bluff an' figgered out the gears. Jim nearly scart me stiff after figgering them for he changed the two intermediates, but I didn't hold mi breth none. I jus' counted their teeth an foun' out I'd been right an' Jim 'd chang'd them to keep me frum gettin' wise. I'd foun' out I wasn't the only one an that week I foun' a copy of the *American Machinist* at the library. It looked good to me, an' I saw a notiz that they pade fur things sent in wich they used. I knew sum of the other boys didn't know how to figger out the gears an' to get it fast in mi nut I made a try tu put it down on paper so I could understan' it. When I got it in shape I'd near swet blood, an', thinkin' of the others who didn't know, I puts 'er in an envelop an' mails 'er. Well, I got a notiz sayin' my contribushun had been receipted an' I waited, an' I waited. Then one day I saw mi piece, at least they had mi name to it. I wuz sore. After all the time I tuk to get that thing done good the editur hadn't left much to it but mi name. I wuz mad, but aftur I'd cooled down a bit I read 'er again, an tuk mi time to it. The editur'd done sum things which made me take notiz. Sum of the things had ben a bit muddy when I wrote them out but now they'd ben made clear. I got tu thinkin' to miself that they'd never think mi stuff woth payin' for, they way they'd treat'd it, an' when I got the check frum the papur it seem'd like sumthin' fur nothin'. I need'd the mun' an tuk the check tu the cashier.

Say, I must 'a spent that "V" 'steen times, ther' wer' so many things I want'd, but Old John, the engineer, waz a teachin' me tu run the engine an' I sent fur a "Tulley." I'd had longin's fur that book but I'd never had the coin tu get it. The rest uv the "fortune" tuk me an' mi steady tu the "Lake" an' we had a boat ride an' sum ice-creme soda. Mebbe I didn't feel that "brain money" burn mi pockit. When Old John quit they gave me the engine an' after I'd run 'er awhile I'd got a better job to the power house. By this time I'd seen mi name in print several times an' I kep' right on a writin' an' a sendin' it in. The more I writ, the easier it becum an' the goods seem'd to stick to me. I studied to write an' I writ'd what I studied. Then I got a raise, not the toe kind.

Onc't I learn'd sumthin' not in the books or the plant. I'd been a visitin' an I told about a place I saw. The man that run it was heftier nor me by 50 pounds an' sum kin' fren' show'd him what I'd said. He came over tu see me an' after he'd gone I bo't sum beef steak. Then I'd foun' sum of mi frens'd argue 'bout what I'd said an' get real personal. An' I fin'lly conclud'd that I'd use a nomme due plum like sum of the big ones. The editur didn't object an' gradu'-ly cut out writin' in my own name, an' it sav'd a heap of argument. Sum of the boys as't me 'bout it an' I 'splained the writin' took too much time an' they want'd to know who the guy wuz who seemed to kno' so much about the lokul doin's. I didn't tell but I kep' right on a writin' an w'ile I'll never get rich quick at the game, there's a big lot more in it than the checks I get. I'm helpin' the other feller an' am a charter member of the league of self-risers, no dues, no admission fees, the only qualifications bein' a bit of grit an' stic'-to-it-iv'ness.

Electrical Department

Especially conducted to be of interest and service to the men in charge of the electrical equipment

Some Features of Induction Motor Operation

By W. A. Hill

When the Willys-Overland Company took over the plant of the Pope Motor Car Company, of Toledo, O., to manufacture automobiles, the factory machinery was group-driven by direct-current motors ranging from 1 to 50 horsepower, the total connected load being about 650 horsepower. In most cases the motors were mounted on the floor in the corners of the rooms; in some instances, however, one motor was used to drive three floors. Upon extending and rearranging the plant it was found expedient to change over to alternating current, the increased load being large enough to justify the central station in putting a transformer substation right on the factory premises.

Three-phase currents at 4000 volts and 25 cycles are transmitted from the central station, about three miles distant, through one-half mile of underground and 2½ miles of overhead feeders consisting of three No. 0000 solid copper wire and a neutral of No. 4 copper wire which is grounded at the power house. The high-tension feeders are brought over the property on poles to a transformer station located at the center of distribution, and there stepped down to 440 volts for power purposes and 115 volts for lighting service. Separate transformers are provided, of course, for the lighting and power services.

Notwithstanding the separation of the secondary circuits, however, the fact that the lighting transformers are supplied with current from the same primary circuit which supplies the motor transformers has caused some difficulty in maintaining constant voltage at the lamps. This is occasioned by the fall and rise of the primary voltage when motors are thrown on and off the circuits; the trouble is worse, of course, when a large number of motors is stopped at one time, as at noon and evening each day—in fact, it is so objectionable that special provision has been made for correcting the voltage variation.

The 115-volt incandescent lamp circuits are supplied from transformers connected star- or Y-fashion at the primary terminals. The primary winding of each of these transformers is provided with a 5 per cent. tap and these taps are connected to one pole of a single-pole double-throw knife-blade switch. The primary terminal nearest the 5 per cent. tap is carried to the other pole of the corresponding switch. The blades of the three switches are connected together, forming the neutral for the star connection. This arrangement is illustrated diagrammatically in Fig. 1.

Normally, when the motors are in operation the primary voltage is pulled down to approximately 3800 volts, which would reduce the secondary voltage of the lighting transformers to about 110 volts if the full primary windings of the lighting transformers were in circuit, and this, of course, would dim the lamps to a very objectionable degree. When the motors are started, the switches are set to supply the lighting transformers through the 5 per cent. taps, thereby reducing the transformer ratio and consequently raising the secondary voltage. Under these conditions the 5 per cent. drop in primary voltage is offset by a 5 per cent. reduction in the turns of each primary winding, giving practically the same voltage in the secondary circuits that the full primary windings would give with the full primary voltage.

After the motors have been stopped the voltage comes back to normal and with the lighting transformers connected as described an excessive voltage would be impressed on secondaries; to prevent this the automatic arrangement shown in the diagram is provided. The operation of the apparatus is as follows:

When the motors are thrown on, pulling down the primary voltage, the switch blades *A*, *B* and *C* are pulled to the right by means of the rope with a handle at *H*, connecting the neutral point to the 5 per cent. taps instead of the main terminals. The weight *E* is lifted until caught by the latch *F* and the switch *D* is closed, completing a circuit through the voltmeter relay *R*. This voltmeter is so adjusted that when the secondary voltage rises to 118 it closes the circuit through the solenoid *M* which trips the latch *F* and allows the weight *E* to fall. The weight pulls the switches *A*, *B* and *C* to the left, cutting in the whole of the primary winding, as shown here, and preventing the secondary voltage from remaining too high. At the same time the switch *D* breaks the voltmeter circuit; consequently, the windings of the meter and the solenoid are not kept in circuit unnecessarily.

A maple stick connects the switch blades and is pulled back and forth by ordinary sash cord running over pulleys. The weight *E* drops on a rubber buffer

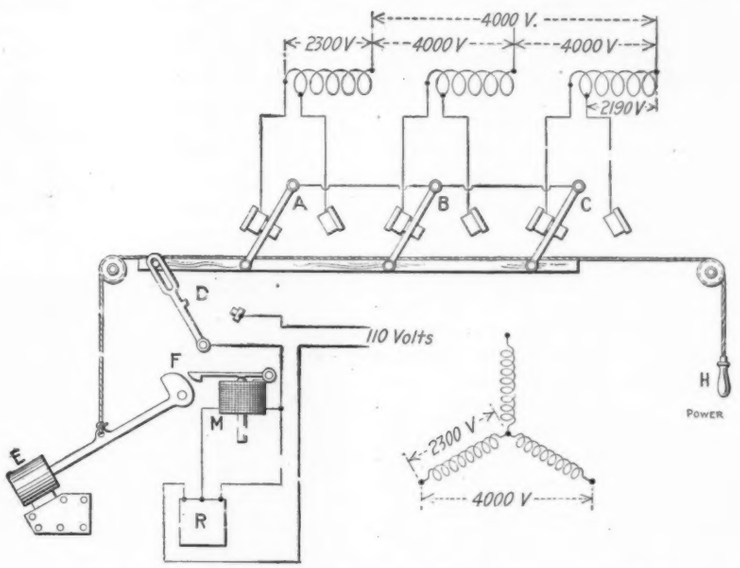


Fig. 1. Diagram of Dev'ce for Changing Transformer Ratio

and, therefore, the switch contacts are not subjected to any extra shock when the weight falls.

Owing to the character of manufacture and plant arrangement, group drive was retained except in a very few cases. The direct-current motors which have been displaced were set on the floor and belted to the line shafts at about 45 degrees. Owing to the amount of space required for the motor and belt, which necessarily

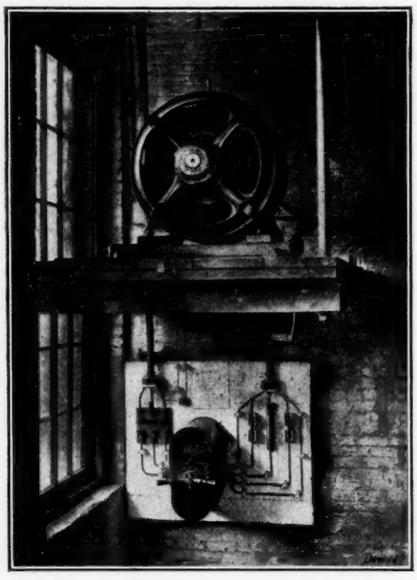


FIG. 2. A PLATFORM EQUIPMENT

had to be boxed in so as to eliminate the possibility of employees coming in contact with it, it was found advisable to either suspend the new motors from the ceiling or mount them on platforms. Most of the motors are of 20 to 50 horsepower, and motors of such sizes are not so accessible when suspended from the ceiling; moreover, the ordinary ceiling will not stand such an arrangement without reinforcement; consequently, the platform installation was adopted. Fig. 2 illustrates one of these. The ceilings average about 16 feet from the floor, and the motor platform clears the floor 8 feet.

In some instances the platform is placed in the corners of rooms, as in Fig. 3, and in others it is located in a convenient space and suspended by 1-inch round-steel rods in 2-inch pipe spacers. The platform frame is of 6x6-inch pine timbers and floored with a double layer of 2-inch planking. The platform is large enough to allow the removal of the rotor without lowering any parts to the floor below. Where the platform is located in a corner the walls carry a portion of the weight of the frame through a projection of the frame timbers mortised into the brickwork. The frame is further tied to the wall by means of lagged straps which pass through the brickwork. Those platforms located away from side walls are suspended by four bolts and steadied by ⅝-inch tie rods and turnbuckles which extend from each corner to the ceiling at an angle of 45 degrees to the edges and surface of the platform. Beneath every platform is a cluster of four incandescent lamps, the function of which is not merely to give light at this particular location but also to indicate whether the power is off or on.

In starting an induction motor one of the running fuses may blow and leave the motor running single-phase; if left in this condition very long, the active winding may be burned out. To detect burnedout fuses, an arrangement is used which consists of a fuse-block with a 2-ampere fuse connected to about six feet of lamp cord equipped with terminals similar to those on a portable voltmeter. Upon connecting this to the terminals of a fuse to be tested, if the fuse has blown the fact will be indicated by the blowing of the 2-ampere test fuse. This is a cheap device and can be used while the motor is running.

Some difficulty was experienced due to the static electricity generated by the slipping of the belt on the iron line-shaft pulley. Various brush devices were tried to take the static charge from the belt, but these soon become deranged and rendered useless from various causes. All motor frames are now grounded through resistors of about 200,000 ohms resistance, made up of two ¼x12-inch round graphite rods; this effectively removes the static charge.

The motors are blown out with compressed air once a week. Compressed air is piped to most departments to op-

FIG. 3. A SIDE-WALL PLATFORM

erate portable tools or to keep machine tables free from chips. Taps are taken from this general distribution system and a ⅜-inch pipe is carried close to each motor, terminating in a valve and the male portion of a hose coupling to receive a hose for blowing out the motor (note the air tap at the left of the motor in Fig. 2).

The oil is changed in the bearings and the bearings washed out with gasolene at least every six months; those located in dirty places are cleaned more frequently. Current readings are taken from the motors at frequent intervals, or whenever a motor appears to be overloaded, a portable ammeter being provided especially for that purpose. As nearly as possible the motors are given full load; by changing motors to suit the load, the power factor and load factor are maintained reasonably high. At present the load factor is 75 per cent. and the power factor 82 per cent.

Telephones in the Power Plant

BY W. H. RADCLIFFE

Amongst the minor devices that have contributed largely toward facilitating the supervision and executive control of power plants is the telephone. In the average power plant, telephones can be advantageously used for communication between the boiler room, the engine or dynamo room, the switchboard gallery, the storage-battery room, the repair shop, the stock room and the offices of the various officials of the company.

Ordinarily, the telephone requirements of a power plant come well within the range of capacity for which intercommunicating telephones are manufactured; the maximum capacity is about thirty stations or telephones. On the front of each telephone set is a button or key for each of the stations in the system. If there are ten stations in the plant there are ten buttons on each telephone; if, in addition, there is one trunk line to a central exchange, there are eleven buttons on each telephone. The buttons are labeled "Boiler Room," "Dynamo Room," "Switchboard Gallery," "Battery Room," etc., and pressing a button automatically connects the caller with the telephone corresponding to the button pressed, and signals the called station by ringing the bell there.

One of the principal advantages of the intercommunicating telephone system for a power plant is its low operating cost as compared with other telephone systems. It is entirely automatic in action; that is, no telephone operator is required to complete the connections, this being done by pressing the proper button, as just explained. There is therefore no operating expense except the renewal of a few dry cells once or twice a year.

Another advantage of the intercommunicating telephone system for power plants is the fact that the service is available at all hours of every day and night. Furthermore, no separate switchboard is needed, the buttons and keys on the telephone sets serving in place of this expensive and rather complicated piece of apparatus.

If more than thirty telephones or thereabouts are required, and if connections with outside parties through a central exchange are of frequent occurrence, the

private exchange system is necessary. A separate switchboard is required in the private exchange system, as well as an operator to attend it, connections between stations within the plant being made by the switchboard operator instead of by the party who uses the telephone.

Whichever system is used, the benefits derived from the prompt giving and receiving of orders and the transmission of information without leaving one's work, the quick adjustment of matters in emergencies and the coöperation among the employees result in a saving of time and an efficiency of operation that are out of all proportion to the expense of the telephone system.

Connecting a New Compound Wound Dynamo

By G. J. Reynolds

While employed as construction foreman for a large factory, I was sent out

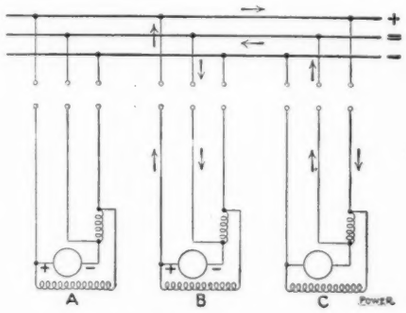


Fig. 1. First Connections

to wire up and start a 100-kilowatt railway generator. This machine was to operate in parallel with two others that were already in service. Before beginning to wire up the new generator, the switchboard was looked over but the connections to the old generators were not

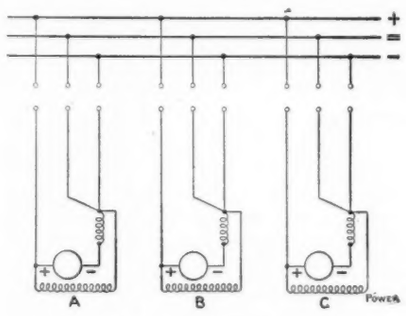


Fig. 2. Second Connections

checked. The positive and negative busbars were easily identified by the connections to the outgoing feeder circuits.

Assuming that the old machines equalized on the positive side, the new generator *C* was wired as shown in Fig. 1 and started, but it refused to generate. In order to restore its residual magnetism, all of the brushes on the machine were raised from the commutator and its main switch thrown in; instantly, the circuit-breakers on the old machines went out. The condition that really existed is easily seen by observing the arrows showing the direction of the current. A short-circuit was thrown on the machines *A* and *B* through the series field winding of the new machine. If all the connections had been normal, the shunt field winding of the generator *C* would have been energized by current from the bus-

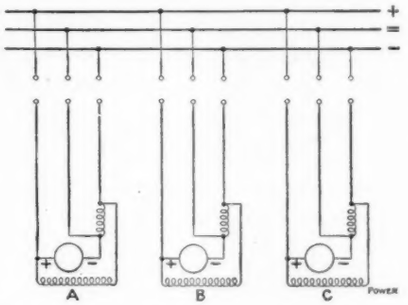


Fig. 3. Final and Correct Connections

bars without interfering with the operation of *A* and *B*.

In endeavoring to locate the trouble we found that *A* and *B* were connected to equalize on the negative side. When making changes in the wiring, the equalizers were connected to the busbar side of the series field windings, as shown in Fig. 2; the machines would not run in parallel satisfactorily when connected in this manner, for the reason that the series field windings were not equalized, as the diagram disclosed. For fear that a mistake had been made in testing for polarity, a portable voltmeter was used to check the one on the switchboard. As an additional but very simple proof, we connected wires to the machine terminals and stuck them into a bucket of water. Bubbles arose from the negative terminal.

After many unsuccessful attempts to parallel the generators, we finally connected them as in Fig. 3 and no further trouble was experienced.

LETTERS

Sparking Brushes Cured by Paraffin

Some time since, the brushes on two motors in our plant began sparking very badly. One was a ¾-horsepower machine running at about two-thirds its full load, and the other was rated at 5 horsepower; both ran continuously from sixteen to eighteen hours per day. The brushes sparked so badly that it was necessary to sandpaper the commutators and brushes two or three times a day. The ammeter showed that the motors were not overloaded, and shifting the brushes did no good.

As an experiment we took the brushes from the ¾-horsepower motor and boiled them in paraffin. They worked "like a charm," and we lost little time in "experimenting" with the other motor, which is now doing as well as the smaller one.

E. D. Nitchals.

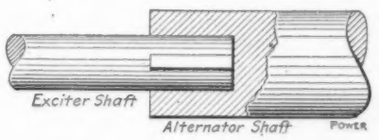
Kansas City, Mo.

[This remedy frequently, but not always, produces the result described. The explanation seems to be that the paraffin increases the electrical resistance of the brush face, which merely increases the difference between the "commutating ability" of a carbon brush and that of a copper brush. The paraffin also lubricates the surfaces and thereby reduces chattering and abrasion.—Editor.]

An Unusual Cause of Commutator Trouble

Some time ago we began to have brush trouble with the exciter of a belt-driven alternator. The commutator became so rapidly and badly injured by sparking that it had to be turned off every two weeks. Our efforts to remedy the trouble were somewhat instructive as we began to make various adjustments which resulted in a better knowledge of the machine and smoother running.

However, we ordered an extra armature and installed it and as everything started off all right we thought our troubles were over. But after two months we had to turn down the commutator of the new armature. On taking out the armature



Method of Coupling Shafts

we noticed a lot of rust where the two shafts were coupled together and this led us to a solution of the trouble. Testing with calipers we found that the hole in the end of the alternator shaft was very much out of truth, the key was worn considerably and these in turn had started to spoil the exciter shaft.

At week-end I had a slide rest taken from a 24-inch lathe and having taken the exciter off the base I blocked up with wood until the tool lined up true with the hole. I then plugged up the keyway with hard wood and started to bore by running the engine as slowly as possible and feeding the tool very gradually. In two hours we succeeded in getting a perfectly round hole ¼ inch larger than the original one. Then we chipped the keyway deeper and straightened it up. The end of the exciter shaft was turned true and a phosphor-bronze bushing was fitted to the new diameters and a keyway cut along its length.

The exciter was again put in operation and up to the present time we have

had no trouble, although we have run it ten months, during four of which the machine has run 24 hours a day.

GEO. H. HANDLEY.

Newburgh, N. Y.

Effect of Impaired Rotor Insulation and Contacts

In a recent number of POWER I noticed a letter relative to an induction motor that refused to carry its rated load. This calls to mind an experience I had some time ago with a 50-horsepower two-phase motor that I rewound after a primary burn-out. The insulating material around the bars of the rotor was carbonized and the bars had been hot enough to oxidize them. As the bolts which held the bars to the end rings were battered over the nuts it was almost impossible to remove the nuts with the tools at hand, so I let the rotor go as it was.

After rewinding the stator and putting the motor in place it ran up to speed when tested with no load. It is direct-connected to a centrifugal pump and as water was not needed at the time I heard nothing of it for some time after. When they began to pump, however, I was notified that the pump was not lifting its usual amount of water. Investigation showed that the motor ran 100 revolutions per minute slower with the load than when it was free. I could attribute this to nothing but extra resistance in the rotor circuit. We made suitable socket wrenches and took out the rotor bars, cleaned the contact surfaces to bright metal with emery cloth, cleaned out the slots and put in new cells of paraffined paper and reassembled the rotor. This remedied the trouble. I think Mr. Blue will find his trouble to be like mine.

F. W. CERNY.

Mesa, Ariz.

The Simplest Current and Polarity Indicator

During the past few weeks this department has contained letters from various correspondents describing different methods of testing electric circuits in order to determine whether the current was alternating or direct; and also in some cases of detecting the polarity of direct-current circuits. All of the methods described were very interesting, and of various degrees of utility and convenience.

I have used for many years a method which might prove interesting to those of your readers who have need for it, and one which I believe has not been mentioned by any other correspondent. Simply tear a small piece off a blueprint, wet it and place the two ends of a pair of wires connected to the circuit to be tested in contact with the blue side of the print. The wire ends should be placed from a half inch to two inches apart, depending on the voltage. If the current is alternating, practically no effect will be produced, but if the current is direct, a white spot will appear under the *negative* wire. Any piece of blueprint paper will do provided it has been exposed.

I. SAWFORD.

Sydney, Nova Scotia.

Can These Alternators Be Operated in Parallel?

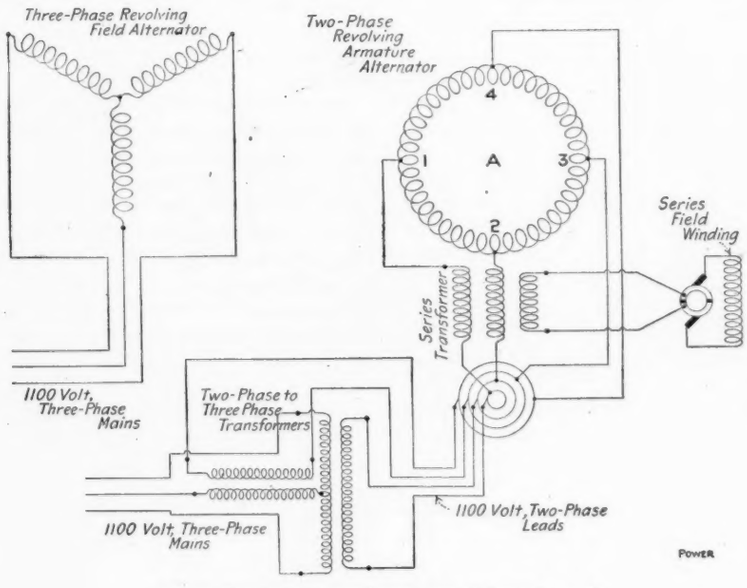
In our plant are two alternators which we wish to operate in parallel through transformers if possible. One is a three-phase 150-kilowatt revolving-field generator and the other is a 120-kilowatt two-phase revolving-armature machine equipped with a rectifier and a compensating winding. Both generate 1100 volts and 60 cycles.

Will some of the other readers express their opinions as to whether the two-phase machine, delivering through a two-phase three-phase transformer, as indicated in the sketch, can be worked in parallel with the three-phase machine? Furthermore, if the two machines can be operated in parallel, would the compensating winding of the two-phase machine have to be discarded altogether and new field-magnet coils installed in order that the field magnet may be energized entirely by the exciter, or could the winding be left as it is and the machine connected as shown in the sketch?

As the load supplied by these alternators is made up principally of incandescent lamps, the power factor may be considered relatively high. There are a few motors, all of them small, and only ten arc lamps; the rest of the load is in incandescent lamps.

D. M. GROVE.

Covington, Va.



CAN THESE ALTERNATORS BE PARALLELED?

Side Stepping Crane Troubles

It is not always the highly educated man but rather the practical man threatened with intelligence and natural resourceful ideas who gets results without looking up his card system—which, however, is of great value.

A short time ago the hoist armature of a 50-ton electric crane became badly grounded, with a load of 60 tons hanging about ten feet in the air and in the middle of a large machine shop. The electrical expert was called up on the jump and decided the armature must be changed; as the load hung in the middle of the shop too low to be bridged to one end and the two other cranes tied up one side, the delay meant dollars and cents to the firm. The idea occurred to the repairman to place heavy paper on the rails of the bridge, rack the trolley onto the paper, thereby insulating the trolley from ground, and lower the load to the wood floor. This was done, the block hoisted up and the crane run to one end of the shop for repairs, with about fifteen minutes' delay all told.

In another instance a hoist controller was burned out with an important job hanging on. The wires to the hoist motor were tapped onto the bridge controller, the job handled, the wires transferred back again and the crane run to one end of the shop for repairs without serious delay to the work.

In another instance one field-magnet coil of a hoist motor burned out with the load on; the coil was cut out and the motor run without it until the job was finished. The repair was made at a more convenient time. A little ingenuity will often save a whole lot of time and trouble in cases of this kind.

WILLIAM PRICE.

Philadelphia, Penn.

Readers with Something to Say

Practical information from the man on the job. A letter good enough to print here will be paid for. Ideas, not mere words wanted

Engine and Piping Changes

A tandem compound high-speed engine gave trouble from the time it was installed about ten years ago. In spite of all that could be done by the engineer in charge, local machinists, or even the man sent by the makers, the engine still pounded and made so much noise that it could be heard for blocks at times. Finally, the crosshead shoe came off, the crosshead dropped down, bending the piston rod, and that broke off the stuffing box which was screwed into the cylinder head.

For six or seven years this engine ran for about 15 hours a day, six days a week for nine months in the year, but for the last three or four years it had only run about 12 or 15 days during the entire year, and every time it became necessary to run it there was a general kick from the fireman.

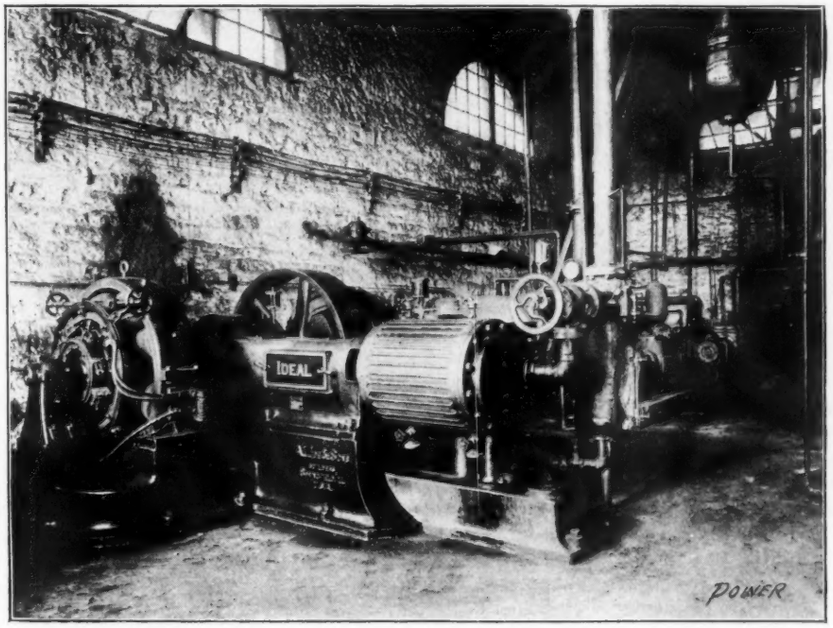


FIG. 1. HOW THE THROTTLE VALVE WAS ATTACHED TO THE STEAM CHEST

The engine was connected to exhaust into the heating system, the back pressure in which varied from zero to 20 pounds. At the higher back pressure the engine would not carry its full load and was a steam eater. The fireman claimed that it made little difference whether the exhaust went to the heating system or not.

The engine was turned over to me with instructions to have the necessary repairs made to put it in a condition to run. I removed the high-pressure cylinder, which also formed the head for the low-pressure cylinder, and separated the high-pressure cylinder from the low-pressure cylinder head by drilling a series of holes around at the point where the front ports entered the cylinder and faced it off. As the high-pressure valve was of the piston type this left a hole through which the steam formerly passed from the high-pressure cylinder to the low-pressure steam chest. A flange was secured over this hole by cap screws, and to this, by means of nipples and an ell, the throttle valve was attached, as shown in Fig. 1.

Another condition prevailed which was unsatisfactory. The steam piping entered the engine room through an 8-inch header. From this header steam was taken out of the top through a 5-inch short nipple and ell, and then through about 4 feet of pipe running at a right angle to the header with a turned-up ell at the end; then through a short nipple and another ell with about 3 feet of pipe running parallel with the header, on the end of which was an ell turned downward and from which the pipe led down to the separator and throttle valve. This formed a large pocket where water could collect, both when the engine was shut down and when running light. When the engine was started or a sudden load came on, more water would come over than the separator could handle. I had this piping taken down and the order reversed, taking steam from the bottom of the header and leaving no point in which water could collect. What condensation there was came gradually to the separator, where it was taken care of. The changed piping is shown in Fig. 2.

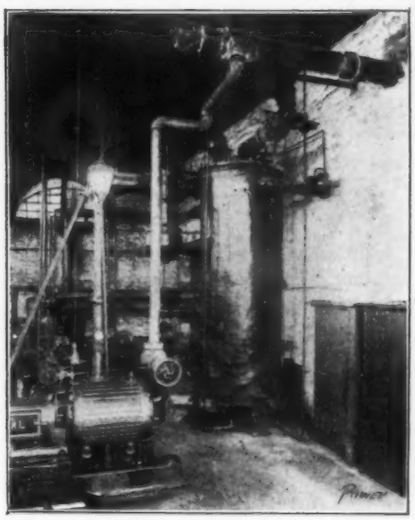


FIG. 2. NEW ARRANGEMENT OF THE STEAM PIPING

The engine was next put together and started up. To the surprise of all, it ran so smoothly that standing 10 feet away one could not hear it run, not only with no load but with full load, when handling a 10 to 50 per cent. fluctuation without the attendant even knowing that there had been a change in the load.

The engine exhausted from the bottom and immediately under the cylinder there was a valve to prevent the steam from backing up into the engine from the heating system when the engine was shut down. The pipe dropped about 20 inches into a trench and extended horizontally about 8 feet, and then turned up and went to the heating system through an oil separator and past the relief valve.

At the ell where the pipe turned up out of the trench there was placed a ¾-inch bleeder valve. With the engine shut down and the valve under the cylinder closed, all of the pipe, including the drop from the engine, the horizontal pipe in the trench and the riser, about 30 feet in all, would fill with water and before starting up it was necessary to drain this pipe by opening the bleeder. All would go well until the water got down to the level with the top of the horizontal pipe, when a water hammer would start. In order to remedy this I removed the valve from under the cylinder and placed it in the vertical pipe at a convenient hight with a bleeder tapped in just above the valve

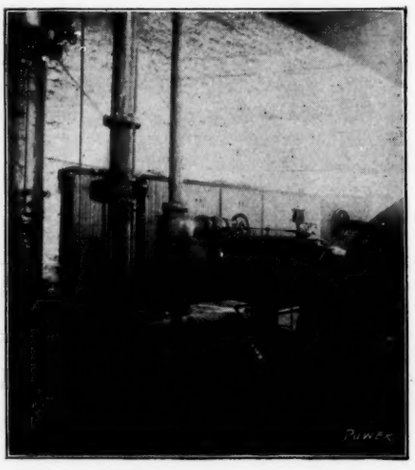


FIG. 3. VALVE AND BLEEDER IN VERTICAL EXHAUST PIPE

to drain what water might collect above this point. This is shown in Fig. 3. Since then I have had absolutely no water hammer. Before this change it was necessary to go over the engine every day, and a straight run of 34 hours was the longest the engine had ever been known to run without a stop for adjustment. Since then I have made runs of 60 hours and there was no reason why it could not have continued in service as there was nothing to be done before starting again.

S. E. SHAFF.

Iowa City, Ia.

Steam Plant Installation Costs

Published articles that would be of permanent value to engineers would be those dealing with the details of methods and materials used in installing engines, boilers and other power-plant apparatus. Also data regarding the prices paid per hour to erectors and other workmen, the time required and the material used for each separate piece of work.

One engineer could give reliable data about an installation of water-tube or fire-tube boilers and another about installing an engine, when they might not be in a position to give reliable cost data on an entire plant.

Descriptions of power plants can be found in almost every issue of technical journals, but very little itemized installing-cost data can be found in any of them.

The small amount of reliable information along this line makes it very difficult for an engineer inexperienced in this class of work to give his employer satisfactory information as to the cost of installing apparatus of various kinds. The novices will generally underestimate the cost and the difficulties of doing good work.

Of course, cost of material and labor vary in different sections of the country, but this matter could be adjusted to suit the conditions existing by the interested investigators.

Supply costs should be complete to the smallest detail to be of real value.

J. E. NOBLE.

Toronto, Can.

Throttling Governor Failure

A rather queer failure of a throttling governor came to my notice lately, which may be of interest.

The 4-inch governor was of the common type without a safety attachment of any kind. One night it was necessary to screw the stem up several turns more than was usual to make the engine carry the load and as shutting-down time arrived steam was cut off completely.

When the governor was taken apart, the pin through the nut was found sheared off, the nut had unthreaded and the plug had dropped down. A new pin was put in place and everything went all right for two or three nights more when it was again necessary to screw the valve stem clear up. Of course, it was expected that the nut had again worked loose, but to the surprise of all hands everything was all right, and when the governor was put together the load was carried with the stem in the usual position for a while, but it soon had to be put up again. When in this position the engine suddenly began to race and only the sprinting ability of the engineer on watch kept the flywheel in one piece. Next day the pipe line was examined for anything that might obstruct the passage of steam, but nothing could be found.

The engine and governor had always been cold when looked into. One more try was made but something still held the steam back. As the engine stopped, I took hold of the governor flyballs and tried to spread them, but with a very slight movement the plug at the end of the stem struck hard against the pin which limits the downward travel.

Here was the trouble sure enough, but as nothing could have made the stem longer the parts in the valve body must have shifted. Another look when everything was hot showed that the brass lining was up about ½ inch above its proper place. The valve body was of cast iron and the brass bushing had been pressed into it but no provision had been made to hold it in place. The difference in expansion between iron and brass allowed the bushing to drop down into its proper place as soon as it cooled off and as no one had never looked at it immediately after stopping, the bushing had never been noticed out of place. A good strong pin now holds it where it belongs.

My theory is that when first warming up the engine a slug of water or perhaps the steam would force it up before the expansion had tightened it.

VERNE L. BALLOU.

Shirley, Mass.

The Human Element in the Power Plant

Perhaps one could find a greater variety of opinions upon the subject of the human element in the power plant than any other; it may also be quite true that no two men can be handled in the same way, in consequence of which no set of rules can be applied in the handling and treatment of subordinates, whereby the most efficient results may be secured.

It is quite true that experience is the best teacher; however, one may have a variety of experiences, covering a great number of years, and yet be utterly incapable of securing results from his assistants, just because the subject never received logical nor analytical consideration.

Recently, a very successful chief engineer of a large paper mill laughed when I mentioned this subject of handling men to him and said that it was something one could learn only by everyday experience. Furthermore, he wanted to know if anybody expected to find out anything through a discussion in POWER upon such a subject. I replied that the space would not be given up to a worthless subject.

His argument was that what might be a good line of procedure for one man would be ruinous for some other fellow to carry out. Furthermore, he was of the opinion that good judgment coupled with hard work and a good physique, together with plenty of push on the part of the subordinate, would go farther toward securing the best results than all the "dope" that could be devised or dug up in a century.

Continuing, he said, "I would rather have one good man than three of the general run of men found in this 'neck-of-the-woods'; really good men are hard to find, that is, men who will take a real, live interest in the plant and work to the end that the very best service may be secured at the least possible cost. In return one should make it worth their while in a material way to do good work and not make it just a 'thank you' proposition. If a man can achieve results

where the other man did not, and perhaps could not, then he should receive a percentage of the saving made."

We both were of the opinion that if a man is energetic, possesses some initiative, is loyal to the chief and not afraid he may insubordinate himself too much, he is pretty sure to be a valuable man to his employer. On the other hand, if he is continually finding fault with the equipment and the management, and works along from day to day in a half-hearted manner, the concern and the chief would be much better off without him. Moreover, any man who requires careful handling and becomes incensed upon the slightest pretext, will not help to form a strong organization, but may be the means of disrupting it.

If a strong organization is desired, and success depends greatly upon the organization, there should be a sort of family feeling among the men, and every man should be a coworker with the chief, so that the plant may be run at the very highest degree of efficiency and economy. If there is a backbiter among the men, the sooner he is eliminated the better for all concerned.

One point which I have invariably noticed is that the wage is not always the sole attraction in securing and retaining valuable men. The candidate for a position asks such questions as, "How many hours will I be expected to put in per day, and will I be able to get a Sunday or two off out of each month? Would I be at all certain of my job, or might I expect to get the 'can' on the slightest provocation? What kind of a man is the chief; is he a grouch or is he one of those fellows that has no feeling for anybody but himself? If I show him what is in me, will he appreciate it and in time advance me when conditions permit?"

I have noticed that the "boys" appreciate little things in a really greater degree than they do the big things; for instance, after a hard day's work and it is two or three hours until quitting time, and nothing very urgent remains to be done, telling them to wash up and go home is only one of the many ways whereby the services of loyal and valuable men are not only retained but enhanced as well.

One more point, if the highest economy in firing and the use of supplies is sought, the men should be informed of the cost of the particular articles which they handle. The fireman should know how much the coal costs per ton; how much it costs per day for coal; tests should be made and the results explained in a simple way, so that they may understand what inefficient management and recklessness cost the company. This is why the chief should receive a bonus, as he will continually be after the men in respect to economy, continually impressing upon them that their success as well as his depends upon following out his methods and instructions.

WALDO WEAVER.

Middletown, O.

Prevented Water Hammer

Following is an account of how I beat a case of water hammer at a very small expense:

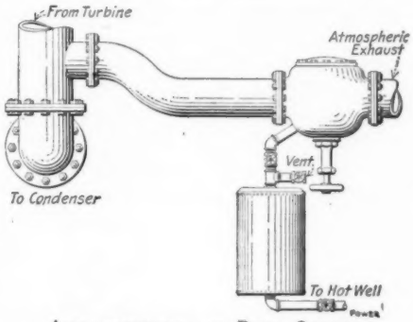
I had only been in the plant a few days when I was startled to hear a loud bang in the cellar and, although I looked over everything carefully, I could not place the noise.

On coming back to the engine room the boys gave me the laugh and said that it was the atmospheric valve pounding on the seat and that it often did that.

I camped out in front of the vacuum gage and after an hour wait it let go again, but it did not affect the vacuum.

During the wait I had figured up how much it would take to lift that 24-inch disk against 28 inches of vacuum and had decided that the trouble was elsewhere.

The accompanying illustration shows



ARRANGEMENT OF DRIP SYSTEM

the exhaust piping from the turbine and that the under part of the casting going to the atmospheric exhaust projects farther than the top side, causing a small percentage of the condensation to drain back into the offset in the line to the atmospheric valve, making a water seal on the wrong side.

The valve leaked and the vacuum drew the hot steam from the auxiliaries on the exhaust line into the cold water; a water hammer was the result.

I got an old galvanized hot-water boiler and piped it up, as shown, so that by leaving the top valve open and the other two closed the water came to the trap by gravity, and by closing the top valve and opening the others I could dump the trap into the hotwell.

At the first opportunity I opened up the atmospheric valve and found both guide stems broken. It was repaired and the disk faced off and there has been no trouble since. I dump the trap every hour and get 10 or 12 barrels of good water every day and that helps here, where the water is bad.

A. STEVENS.

Renfrew, Penn.

Corroding Economizer Tubes

I would like to ask if any reader has had trouble with corroding economizer tubes?

My economizer is placed between the boilers and chimney. The water is pumped through closed primary and auxiliary heaters and through the economizer to the boilers. The water enters the economizer at from 170 to 200 degrees Fahrenheit and leaves at a temperature of from 220 to 242 degrees Fahrenheit.

It is opened up once a year and a tube scraper run through the tubes and the headers are cleaned out; a soft scale more than ¼ inch thick is found and looks like oxide of iron. It is not like the scale in the boiler tube, but forms in bunches and ridges, much resembling barnacles. Under this deposit the tubes are wasting away and some of them are not more than half of their original thickness and many are giving out.

The feed water is taken from the river and is considered good, it does not contain more than a trace of free carbonic acid and in the boilers it forms a slight scale that is quite hard. Soda ash and some kerosene are used. The economizer has been in service eight years.

If any engineers have had the same difficulty and found a remedy, I would like to know what it was.

C. B. SMITH.

South Framingham, Mass.

Trouble with Refrigerating System

There is one source of trouble in a refrigerating system upon which I have never seen any comments. In a system where brine is used as a refrigerating medium and where air is passed over (or through) the cold brine, the hot vapors are carried from the rooms that are being cooled to the brine tanks in which they are condensed. Thus the quantity of the brine is increased and its strength consequently reduced. The required density can be maintained only by removing the excess water by evaporation or by adding brine-making material.

It is this evaporation that I would like to see discussed. In my plant there is an overflow pipe from the brine tanks to a concentrating tank in which there is a set of steam coils to evaporate the excess water. When the brine is boiled down it is pumped back to the brine tank. I have had considerable trouble with this concentrating tank and with the steam coils in it. Due to its nature the brine is severe on iron when the brine is at or near the boiling temperature. I have to renew the coils about every four months and the tank itself does not last over two years. I have experimented with different kinds of coils without great success.

Stratford, Ont. W. G. WALTERS.

Questions Before the House

Comment, criticism, suggestions and debate upon various articles, letters and editorials which have appeared in previous issues

Connecting High Pressure Drips to Heating Mains

I think that Victor Borm, in the February 21 issue, in trying to criticize W. T. Meinzer on the subject of connecting high-pressure drips to the heating mains, does not realize that condensed steam under a high pressure contains more heat units than under a lower pressure. Mr. Borm says that if the high-pressure traps were made to perform their function there would not have been very much heating done in the sewer. With Mr. Meinzer's arrangement the drips from the high-pressure traps are discharged to a lower pressure, part of the drips reevaporates and goes to the heating main and does work; the remainder goes to the return pipe. I think that this one point of economy is enough to justify the change made.

If there is not economy in saving the drips, why do engine builders do so? For instance, take the arrangement of steam jacketing and receiver reheating pipes on a triple-expansion pumping engine. Various arrangements are used but the following is simple and typical: Steam from the main steam pipe near the engine passes to the high-pressure jacket at boiler pressure, then to coils in first receiver, then through a reducing valve to the intermediate jacket and out to coils in the second receiver, then to a trap and from the discharge of this trap to the low-pressure jacket. The condensation from the exhaust side of the high-pressure cylinder, first receiver and inlet side of the intermediate cylinder goes to the low-pressure jacket, a valve being placed in the pipe so as to maintain the required jacket pressure. The outlet from the low-pressure jacket goes to a water seal in the basement of the building. The condensation from the working steam of the exhaust side of the intermediate cylinder, second receiver and inlet side of the low-pressure cylinder also goes to a water seal in the basement.

An illustration of the saving made possible by suitably employing high-pressure drips is that of a cross-compound condensing engine which once came to my notice. When the engine was installed, a testing engineer was sent by the builders to prepare and conduct the acceptance test. After getting ready he made several preliminary tests. He experienced some difficulty in getting the engine to perform the duty required. Among the several changes which he made one affected a high-pressure steam trap that removed the condensation from the coils in the receiver to the hotwell. Its discharge was connected into a pipe that drained the condensation of the working steam in the receiver to a trap. Part of the drips from the high-pressure trap reëvaporated and did work in the low-pressure cylinder. The tester claimed that this change caused a good gain in the duty of the engine.

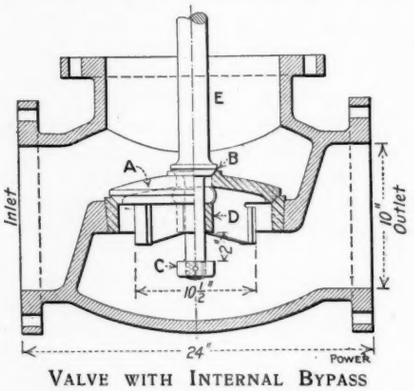
Mr. Borm states that he wonders why Mr. Meinzer did not think of putting in a back-pressure valve. This would undoubtedly have been more effective in preventing the back pressure from blowing the seal into the drip return; also, it would have been more simple.

R. E. ENIGNE.

Kansas City, Mo.

Special High Pressure Valve

I read with great interest the articles in recent issues of POWER dealing with the danger to boilers and piping when opening a stop valve suddenly. As to the side from which steam should enter a valve, I fully agree that the steam should act on the bottom side of the valve; that is, the valve should close against the pressure. But with large valves and high pressures the opposite may sometimes be adopted with advantage.



VALVE WITH INTERNAL BYPASS

A bypass arrangement should be fitted to all high-pressure valves over 4 inches in diameter to help when opening or closing the valve. Most engineers know that it is next to impossible to open a large parallel slide-type valve without using the bypass arrangement.

A few years ago I worked with Richard Pohle, Limited, of Riga, in Russia, when they were constructing the new electric-power station at Windau. All large valves, according to specification, were to have an arrangement for slow opening and be fitted with bypasses.

We made a valve after the design shown in the accompanying figure. In this valve the pressure comes on the top of the disk. This arrangement was preferable as we had experienced considerable difficulty in keeping large valves, closing against the pressure, from leaking when shut.

What the total pressure against a valve disk really is, only few engineers know. In the case of a 10-inch valve under 150 pounds pressure per square inch the total pressure would be upward of five tons. To keep the valve from leaking, the spindle must force the disk downward with at least six tons' pressure. For the Windau power station we therefore preferred to let the steam help to keep the valve tight.

Referring to the figure, the spindle *E* has a collar *B* which acts as a bypass valve in the topmost part of the disk *A*. The lower part of the spindle passes through a guide *D*, cast as a part of disk *A*, and is fitted with a nut *C* which allows the spindle to be lifted 2 inches before acting on disk *A*. The slightest turn of the spindle will admit steam through the bypass *B*.

A. WIND.

Penn, England.

Action in Emergency

The description of the engine wreck at the Boott mill, Lowell, Mass., reminds me of two experiences along the same line which I have had.

The first took place in a five-story mill with a 2000-horsepower engine. Owing to the distance of sections of the mill from the engine room, the manager decided to have the mill wired and to have push buttons located in every room. Then, in the event of an accident, an overseer could ring the emergency bell in the engine room as a signal to shut down.

As first arranged, the push buttons were fastened to the walls without cover or notice relative to their use. One forenoon, about a month after the system

was installed, the bell rang and before I had the throttle valve half closed the bell rang again. When the machinery began to slow down, the superintendent, the master mechanic and some of the overseers came to inquire where the trouble was. Not having an indicator on the line wire I could not say from which room the alarm came.

After the officials had investigated and found no cause for the alarm being rung in, the order was given to go ahead. In about half an hour the superintendent came back and said, "Who authorized you to stop the engine when that bell rings?" I replied that no one, in just so many words, but that I had been consulted in regard to its location, had helped to install the system and I took it as generally understood that I was to shut down when signaled. "Well," he growled, "hereafter when that bell rings don't stop the engine until you get word from me or the master mechanic."

I had thought him a lightweight and that superficial remark confirmed my opinion—the absurdity of such an order! There were three large mills and both superintendent and master mechanic were liable to be anywhere about the works, therefore, often difficult to find. But, fortunately for me at least, the manager had an automatic engine stop and speed limit installed to be operated through the system of wires already in use.

In another plant I worked under a very different type of superintendent. The engine was a compound, size 24 and 44 by 72-inch Corliss and ran at 62 revolutions per minute. This engine was not fitted with safety cams to prevent the engagement of the steam-valve latches when the governor is at the lowest point. On account of its hight the starting valve had to be operated while standing on a step ladder, always kept there for the purpose.

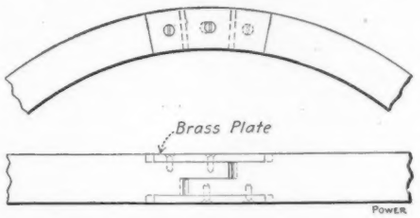
One day, while working at the bench, I heard the engine speed up, and looking around I saw the governor had stopped, which startled me so that I thought of a number of things in a very short time. My first impulse was to mount the step ladder and shut the starting valve, but the accelerating speed of the connecting rods convinced me that the process would be altogether too slow, so I jumped down to unhook the wristplate. At that instant, however, I realized that the consequences of instantly arresting the valve motion at an unknown point in the stroke might be disastrous. So, I grabbed a lever connected with the governor and raised the balls to their highest point; this prevented the valve latches from hooking on. I held them in that position until the engine had nearly stopped, then I released the lever, ran up the step ladder and shut the starting valve.

In a moment the superintendent came in and with the help of a machinist and an electrician we straightened out the tangle and had the engine going after a few minutes. This superintendent, instead of trying to browbeat me for the slight shutdown throughout the mill, complimented me on my quick action in preventing what might have been a very serious accident.

Clinton, Mass. J. W. PARKER.

Piston Rings

In the March 7 issue is a contribution on piston rings by Lloyd V. Beets in which lap-joint and diagonally cut piston rings are criticized. The criticism is well taken. An improvement which I have found to be satisfactory is shown in the



ARRANGEMENT FOR PREVENTING LEAKAGE

accompanying figure. Care must be taken with thin rings to use tap screws of proper proportion.

GEORGE H. HANDLEY.

Newburgh, N. Y.

Neglecting Opportunities

The editorial in the March 14 issue entitled, "Neglecting Opportunities," certainly is worthy of considerable notice and serves as food for thought on the part of a majority of the men who are operating isolated plants.

The assertion that certain men are contented to let a piece of apparatus run in any condition is only too true and, as a rule, they will not put it in proper condition unless compelled to.

In regard to getting after a repair job as soon as possible, such men often do put it off until Sunday, and frequently it happens that the apparatus gives out before that day comes, resulting in a shutdown which at times proves very expensive.

As far as thinking that you may make a thing worse instead of better is concerned, a man who thinks this way, as a rule, generally does make them worse when he gets at them; the only way to do a good job, so far as I know, is to determine to do it and then go ahead.

A great many men do poor work simply because a job is distasteful to them and in their eagerness to get it off their hands do it in any old way as long as it will stand up until they leave the job.

Any man who will allow a number of tubes or nipples to leak in a boiler is indeed a poor business man for, as the editorial states, he could make them tight in a very short time if he would only get at it.

With reference to leaky and improperly set engine and pump valves, I venture to say that if engineers generally would formulate a plan to examine and test the smaller apparatus intrusted to their care, a good deal of power-plant loss would be done away with and the central station would have less to do.

H. H. BURLEY.

Brooklyn, N. Y.

On Assisting the Inspector

It is a remarkable fact that those men who by training, experience and general knowledge are best qualified to judge every condition affecting the plants under their charge are the very ones who afford every possible aid to a boiler inspector, while those whose conceptions are of the very crudest concerning the proper maintenance and operation of the machinery in their keeping view the service of inspection and supervision with everything from good natured indifference to open hostility.

The same conditions seem to obtain among owners. Let any movement be started toward a provision for more rigid supervision of boilers and a great hue and cry goes forth. Many a costly object lesson is required and perhaps many lives sacrificed before opposition is sufficiently removed to allow a betterment of conditions.

I am a boiler inspector and, operating as I do in a field where absolutely no form of regulation is provided by statute, I am often brought face to face with conditions of ignorance and indifference that are absolutely appalling. Time and again have I known of the inspection service being refused because of the safety limitations imposed, even when concessions beyond what good engineering practice would dictate had been granted. In one instance, perhaps the most cold blooded that has come to my notice, I was severely upbraided by an owner whose partner had made application for inspection, when I told the engineer of the dangerous condition of a boiler he was operating. The boiler was twelve years old, designed for 125 pounds pressure and was at that time carrying 190 pounds. I do not doubt that my judgment was a matter of considerable derision, for I was informed that other boilers of the same type had carried over 200 pounds and still held together. I did not dare attempt to explain safety factors for fear that anything below the ultimate strength would be considered all right.

Between the inspectors and many so called engineers it is a constant source of friction to find safety valves screwed down to points where release of all the steam generated is impossible, to find the gage hands set back and other arti-

fices intended to deceive. I will say that this practice is most common on the boilers used for logging purposes and where few engineers as we understand the term are found. It is a matter of real pleasure to find one of the three gage cocks on these rigs in working order, while for all of them to be in order should make the engineer almost deserving of honorable mention.

There is one thing, however, to be brought to the attention of a great many engineers, men who are really skilled good men, men who are making real successes at their vocation, and that is the conditions under which an inspector is required to work. In many of the plants the boilers are not or for some reason cannot be sufficiently cooled and the heat is terrific. More than a passing glance at the various portions is beyond human endurance. Even at that, there is little that the inspector misses but a little less onerous conditions would add to his efficiency.

Then, there is that matter of cleaning the parts sufficiently. How much less effective must an inspection be and how much it adds to the disagreeable part of the work, to dig out the buried blow-off pipes, to crawl around in a foot or two of soot and ashes to look over with minute care several thousand feet of tubes and a number of drums and headers. It is little wonder that cases of incipient failure and the progress of corrosion and attendant evils escape the notice of one working under such handicaps.

The more frequent use of the hydrostatic test has been suggested as one means of reducing the number of disastrous failures. Yet, there is a question as to whether the strain so set up at the time of such a test, commonly 50 per cent. in excess of the working pressure, might not cause incipient failure not discernible at the time, especially in the case of buried and covered drums and the seams of horizontal tubular boilers. Little uneasiness need be felt regarding those boilers which are free of access and whose parts can be well examined, even if subjected to the visual test only.

Perhaps the best and safest plan to pursue is to adopt some such rule as that in force in the State of Massachusetts, fixing a factor applicable to the age of the boiler, for the fact that the material undergoes a change is very apparent from the manner in which the metal of an old boiler works when attempts to use it for other purposes are made, and one is often led to wonder that it lasted as long as it did when the crumbly, brittle and nonfibrous nature is noted.

Unfortunately, instead of thus reducing the burden upon a boiler whose age should be respected, even if not respectable, the common practice is to add more pressure as the business grows, then to place in the battery boilers of newer, later type and let the old well tried servant continue to carry the limit. How many plants are found with such units in them, where the pressure is limited only by the original design of the oldest boiler in the plant. No comment is necessary on this practice, yet owners and, in many cases, operators, would have to be shown signs of actual distress before discarding them.

At most, upon finding undesirable conditions, the inspector can only recommend the cancelation of the insurance. At that, his influence often ends. This fact is frequently taken advantage of by both owners and operators. To overcome the handicap imposed by these conditions, the inspector is required to be more or less of a diplomat. He must accomplish by other means than the absolute authority of Federal and State officials, the safeguarding of the lives and property of those most concerned and at the same time maintain pleasant business relations between his employers and their clients. Considerable judgment and decision are necessary to require immediate action in place of promises and to refuse to accept faulty arrangement even if immiment danger cannot be pointed out.

Certainly a little thought along the foregoing lines will make it easily apparent to any engineer in what manner he may for his own part help to make the work of an inspector a still greater medium of safety. With the proper cooperation and influence of the engineer, the present appalling list of disasters can be reduced to the minimum.

HORACE HANKS.

Portland, Ore.

Burning Lignite

Referring to Mr. Bergman's letter under the above in the March 7 issue, I wish to say that I have been burning North Dakota lignite for about eight years and have obtained higher efficiency from boilers and grates with lignite than with any other soft coal. This is due no doubt to its cleanness; it forms no soot on the tubes during an 8- or 10-hour test and such a test can be run without making a general fire cleaning. This may not be true, however, of all the Dakota lignites. The Wilton coal is considered to be of the best grade. It has a heat value of about 7000 B.t.u. per pound, contains from 5 to 6 per cent. ash and from 35 to 40 per cent. moisture.

Mr. Bergman states that he evaporated four pounds of water per pound of coal, which contained 6029 B.t.u., and secured an efficiency of 68 per cent., which I consider to be a very good showing.

Lignite burns much like wood and does not require much air. As a general thing too much air is admitted and the heat is carried through the boiler and lost up the stack. It has been truly said that in order to generate steam there are only two steps required: First, produce the heat, and, second, transfer the heat to the water in the boiler. I have made many tests with lignite and under favorable conditions have evaporated 4.86 pounds of water per pound of fuel, containing 35 per cent. of moisture, 5.92 per cent. of ash and 6591 B.t.u. This is equal to evaporating 8.80 pounds of water into steam from and at 212 degrees Fahrenheit per pound of combustible, and shows an efficiency of 76.98 per cent.

Engineers employed by the Government have made tests with North Dakota lignite and from the reports of such tests that I have seen no such efficiency was obtained. No doubt the poor results were due to the fact that those who were in charge had not learned how to burn North Dakota lignite. Many have turned down lignite for the same reason, but some day the large fields of lignite will be of great value to the people of the United States. I regret to see the Government use coal from Pennsylvania and Ohio for its buildings in this State.

C. P. LARSEN.

Bismarck, N. D.

Smoke Abatement

In the March 21 issue, I notice that Waldo Weaver makes some criticism of my letter in the January 3 number on the smoke problem.

It may be true, as he says, that it requires a good man to use the coking method of firing; but so far as my experience goes, it requires a man with no more physical capacity than the other methods and gives far better results as regards economy and smoke. As far as keeping steam is concerned, none of the plants where this method is used, to my knowledge, has had any difficulty in producing all the steam it required. In fact, these plants have been keeping up the pressure with one less boiler than was formerly used, mainly due to the increased economy resulting from this method of firing, since through this method all of the volatile matter which formerly went up the stack in smoke is now consumed, resulting in a considerable increase in evaporation per pound of coal or, for the same steaming capacity, a considerable reduction in the amount of coal fired. When it comes to forcing a boiler beyond its normal capacity, no method of firing can be used which will result in smokeless combustion. If one fires frequently with a thin layer of fresh coal all over the fire, a very considerable amount of volatile matter is driven off in smoke and is unconsumed. This is never economical, nor is it preventing smoke.

The question of which method to indorse is a question of which is the most satisfactory from the smoke-prevention standpoint and economy. The fact that

the spreading method is used far more frequently than the coking method is due to its being easier, not necessarily more economical.

I quite agree with Mr. Weaver that the bonus system of payment is well worth considering.

HENRY D. JACKSON.

Boston, Mass.

The Benefit of Organization

Mr. Levy hits the nail on the head in the February 28 issue when he says in his letter under, "Engineer or Laborer": "There is no mistaking the fact that the engineers of this country must organize. Not only engineers but every man engaged in the generation and transmission of power should be a member of one organization." The engineers and firemen of this city have just formed an organization such as he mentions, called the Brotherhood of Power Workers, composed of engineers, firemen, oilers and other power-plant workers. The consolidation of all power workers into one organization has proved a good move and the engineers, firemen and others can readily see that it is to their advantage to pull together.

According to a circular being distributed, there is nothing in the rules or by-laws of this organization that the most timid and conservative need object to. I quote a few lines from the circular:

"This organization does not demand a uniform wage for its members as conditions differ in every plant. It does not demand recognition of the brotherhood or the signing of agreements; neither does it ask that none but members of the brotherhood be employed in any particular plant. It has eliminated everything that would cause needless friction between its members and their employers. The brotherhood has a labor bureau for the benefit of unemployed members, also a system of education on trade lines that will raise the efficiency of the membership. License legislation and enforcement of the present law will be followed up. It will pay a sick and accident benefit of $5 per week and at the death of a member his beneficiary will receive $1 for each member in good standing. To raise the efficiency of power workers, to secure the results due a higher efficiency and to establish an insurance department that will bury the dead and care for the sick and disabled members, is the work cut out for this organization."

It will be seen from the foregoing that possible causes for friction are removed, such as the demand for "closed shop," etc. The organization is not affiliated with any labor union (though it is not opposed to unions) and has provided for fine or expulsion of any member who takes the position of any organized worker trying to better his condition. The brotherhood has received inquiries from many of the surrounding cities and towns asking for information. It is said that steps will soon be taken to organize this section of the State.

C. C. HARRIS.

Springfield, Mass.

Pumpless Condenser

I read with interest Mr. Fryant's article in the March 7 number concerning a pumpless condenser. Here in the copper country there are several such condensers. In the plant where I am engineer there are two; only one of these is ever in use at one time. The exhaust of three engines is received by the condenser a part of the time.

The condenser is about 75 feet above the engine-room floor and there is about 50 feet of horizontal exhaust pipe before the rise to the condenser begins. Water comes to the condenser under a pressure of about 40 pounds. The reason why the condensers are so high above the engines is because the discharge water is used for cooling the jackets of a blast furnace which is considerably taller than the power house.

F. W. BAIR.

Hancock, Mich.

Grouting Bedplates

I take exception to that part of Mr. Knowlton's article in the March 14 issue which deals with the wedging and grouting of engine bedplates. First, he states that when using concrete foundations the bottom of the bedplate cannot be planed. But, what is the use? Seeing that the bedplate and cylinder have to be leveled and alined, and there is to be at least 1½ inches of grout put under the bedplate, it is a useless expenditure of time and money to plane the bedplate. Further, the grout will not take as strong a hold on a machined surface as it will on a rough one.

If the grout is properly placed it does not make any difference whether a rib is 4 or 6 inches wide as far as the prevention of end motion is concerned. Nor is it necessary to have machined wedges with which to level up an engine bedplate as he states. The practice of two of the largest engine builders in America bears me out in this. The usual supply of packing plates and wedges furnished to their road men is made from ordinary bar steel and consists of plates of assorted thicknesses, such as ⅜, ½ and ⅝ inch and 2 or 2½ inches wide by about 5 inches long. The wedges are made of the same material, but drawn to an edge of about 1/16 inch. As these wedges and plates are usually pulled from under the castings by the erecting men before leaving the job and either left on the premises or thrown away, it will be seen that it is not good economy to furnish very expensive material.

Assuming that the foundations are built of concrete (in modern practice this material is used almost exclusively) if the upper surface of the foundations is smooth, it should be roughed up, with either a diamond-point chisel and sledge or a pick, and then thoroughly cleaned of all fragments and dust. After placing the bedplates and cylinders and raising them to and leveling them at the proper hight the surface of the foundations should be thoroughly wetted with clean water.

Should pockets or spaces between ribs in the interior of the casting not be provided with vent holes, short pieces of ¼- or ⅜-inch pipe can be bent into a U-shape and inserted in each pocket or between the ribs that have no core holes cast in them. The pipes should be stood in a vertical position, so that the upper ends will be at least 6 inches above the surface of the foundation. A dam built of boards or other material can then be built around the engine at a distance of 4 inches from the edge of the casting. The dam can be made practically water tight by placing ordinary sand against the outside. Grout can now be mixed in a box made for the purpose. The proportions should be one part of sand and one of cement. Water should be added until the mixture is of the consistency of good thick paint. It may then be bailed out of the box and poured under the casting until it reaches a hight of at least 4 or 5 inches above the bottom of the castings.

After a lapse of 48 to 60 hours the grout will be found to be hard enough to require a hammer and chisel in cutting away all of the surplus material extending outside the bedplate.

The purpose of the U-tubes is to allow the escape of any air that might otherwise be trapped when the grout was poured. The trapped air might prevent the grout from flowing under the casting evenly if there were no means provided for the escape of the air.

After the grout beyond the edge of the casting has been trimmed off, the job is completed and the engine about ready to start. The wedges can be withdrawn and the U-tubes cut off with a hammer and chisel at the face of the bedplate. It is a safe plan to remove the wedges as this will eliminate any tendency of the engine to move. It is a well known fact that two metal bodies move more easily on each other than metal resting on some other material such as concrete. If the surface of the foundation has been properly prepared so that the grout can form a good bond to the foundation, there need be no fear of the engine moving, even if anchor bolts should become loose.

JOHN F. NAGLE.

Pittsburg, Penn.

Inquiries of General Interest

Questions are not answered unless accompanied by the name and address of the inquirer. This page is for you when stuck—use it

Loss of Steam Through Nozzle

What would be the loss in horsepower per hour through a nozzle if the circular opening at the end is 11/64 inch in diameter, blowing into the atmosphere with 110 pounds boiler pressure?

R. A. H.

The opening at the end of a short, smooth converging nozzle may in this case be regarded as an orifice from which the steam will issue at a velocity closely approximating 900 feet per second. The area of a circular orifice 11/64 inch in diameter is 0.0232 square inch, and at a velocity of 900 feet per second there will be discharged

$$\frac{0.0232 \times 900}{144} = 0.145 \text{ } \textit{cubic feet}$$

One cubic foot of steam at 110 pounds gage pressure weighs 0.2791 pound and the discharge per hour will be

$$0.145 \times 0.2791 \times 3600 = 145.65 \text{ } \textit{pounds per hour}$$

Calling a boiler horsepower the evaporation of 30 pounds of water per hour, the horsepower required to supply the steam blowing through an 11/64-inch nozzle at 110 pounds pressure will be

$$\frac{145.65}{30} = 4.855 \text{ } \textit{horsepower}$$

Using Napier's formula

$$W = \frac{A\,P}{70}$$

for the flow of steam from an orifice, in which

W = Pounds of steam discharged per second,
A = Area of orifice, square inches,
P = Absolute pressure, pounds per square inch,

the flow would amount to

$$\frac{0.0232 \times 125}{70} = 0.041 \text{ } \textit{pound}$$

and

$$0.041 \times 3600 = 147.6 \text{ } \textit{pounds per hour}$$

$$\frac{147.6}{30} = 4.92 \text{ } \textit{horsepower}$$

Waterproof Belt Dressing and Cement

Please give me formulas for waterproof belt dressing and waterproof belt cement.

W. N. K.

Gutta percha dissolved in enough bisulphide of carbon to make a liquid of the consistency of molasses makes a reliable waterproof belt cement.

Neatsfoot oil containing 10 per cent. of dissolved beeswax makes a dressing which preserves the leather and makes it somewhat repellent of moisture. A repellent quality can be imparted to the leather during the tanning process by the use of bichromate of potash.

Single Valve Engine

What is meant by the term single-valve engine?

S. E.

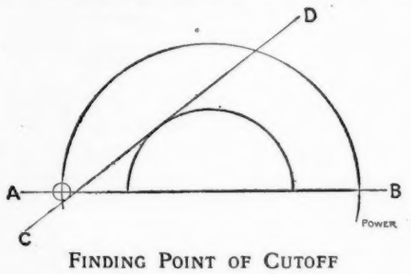
A single-valve engine is one in which one valve controls the admission, distribution and exhaust of steam for both ends of the cylinder.

Point of Cutoff

If the travel and lap of a plain slide valve are given, how can the point of cutoff be found?

V. C. P.

On the line $A\,B$ draw a semicircle with a radius equal to one-half the valve



FINDING POINT OF CUTOFF

travel. From the same center draw another with a radius equal to lap of the valve and at the intersection of the valve-travel semicircle and the line $A\,B$ a circle with a radius equal to the lead of the valve. Then where the tangent line $C\,D$ cuts the outer semicircle will be the point in the path of the crank pin where the cutoff will take place.

Protection for Cotton Hose

What preparation can I use on the outside of cotton fire hose to prevent decay?

H. C. P.

None at all. Keep it perfectly dry and free from dust that may collect and hold moisture.

Motor Operation on Circuit of Higher Voltage

Can a 110-volt motor be operated on a 220-volt circuit without injuring it? If so, how?

L. S.

Yes; by connecting it in series with a resistance the number of ohms of which is equal to 110 ÷ *motor current*. It must be operated at constant load; if the load is reduced the motor speed will increase, and *vice versa*.

Alternating-current Phase Relations

Is the working or power component of an alternating current in phase with the wattless current or with the impressed e.m.f.?

F. W. G.

It is in phase with the impressed e.m.f. Two different components of anything cannot coincide; if they did there would not be two of them.

Steam Consumption and Power Factor

If the power factor of the load on an alternator is 80 per cent., will the engine driving the alternator take more steam or less than it would with 100 per cent. power factor, the true power being the same in both cases?

C. W. N.

Slightly more steam, due to the fact that the armature losses are greater with the lower power factor. For the same true power and terminal e.m.f., the armature current will be 25 per cent. greater at 80 per cent. power factor than at 100 per cent. The difference in total driving power required, however, is very small, because the increase is 25 per cent. of a small percentage of the net output.

Gas Engine Power and Cylinder Temperature

Does the power of a gas engine increase with an increase in the cylinder temperature?

F. E. W.

Not necessarily. When it does, the increase is not great enough to justify running the engine over-hot.

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POWER

Merit and Bonus System Combined

In a special message to Congress, President Taft transmitted the twenty-seventh annual report of the Civil Service Commission. The report shows that the commission is in favor of the merit system, because it is indispensable to economy and efficiency in governmental affairs.

The commission urges legislation looking to increased efficiency in the service, especially a reclassification of salaries in accordance with the work performed, with enough grades to insure frequent promotion.

Although the merit system will work to the advantage of large corporations and those employed by them, and also to the benefit of power-plant owners, it is not so attractive to engineers and firemen employed by them.

It would seem that a combination of merit and bonus systems would work well in the power plant. If this kind of a system were adopted, it would not mean that the man who did good work would occupy the best position, but that the man who did good work and operated his shift more efficiently than the other man would be the favored one.

For instance, a power plant is operated with three shifts of men. On each shift there is an engineer, an assistant engineer, two oilers and four firemen. The men on each shift draw the same pay and use the same amount of supplies and fuel. In fact, one costs the company as much money as the other.

The engineer of one shift, however, begins to take an interest in cheaper operation. He has a talk with the chief engineer who agrees to give the men a certain percentage of the money they can save the company by being more careful in the use of supplies and in the consumption of fuel. The men on the shift are notified and every avenue of needless waste is closed. There can be no doubt but that this shift will make a better showing than the other two shifts in the cost of delivering electrical energy to the switchboard.

And it is not far to look for the reason. The men of one shift have been working for additional pay; the men of the other two shifts have simply been working to earn their weekly wage. Let them know that the men of one shift have been drawing a bonus of a dollar or more per week, because they used a little extra precaution in doing their work, and a protest will be made because they also have not been given an opportunity to make extra money. In one case the men were merely holding their jobs and firing coal; in the second case they shoveled coal with intelligence and were paid according to their ability to save.

Not glory nor a burning desire to save the company money prompts a fireman to save coal, or an engineer to prevent needless loss of steam because of leaky valves, the incentive is the dollar. Hang one up and men will struggle to reach it. Tell them it is theirs if they earn it, and they will fight for it. Tell them that a percentage for every dollar saved over existing operating conditions in the power plant will be theirs, and a saving will be made in the operating expenses of the plant.

A bonus to the men rather than a check to the coal dealer for an amount several times in excess of their increase looks like a profitable investment. Try it out and see.

Low Pressure Turbines with Gas Engines

In a gas engine having an efficiency of thirty per cent., seventy per cent. of the heat furnished to the engine, minus the small amount lost by radiation, is voided in the jacket water and the exhaust. The jacket water may be delivered at a temperature approaching that at which water will boil at atmospheric pressure. The exhaust gases leave at temperatures upward of a thousand degrees. The jacket water, if placed in a vacuum, would, without further heating, give off considerable steam which might be used in a low-pressure turbine, and the gases could be used in a boiler which would furnish steam at a higher pressure. The two could be used in a mixed-flow turbine, or the jacket water could be used as the boiler feed and all the steam sent to the turbine at the higher pressure.

The hot gas as it comes from the producer has, by reason of its high temperature, considerable potentiality for steam making, but this is largely absorbed by the boiler or vaporizer which makes steam for the producer itself, and any attempt to take low-pressure steam off from the hot water coming from the wet scrubber would probably involve

trouble from carrying impurities into the turbine.

The possibilities of the subject are discussed in an article by Edwin D. Dreyfus in this issue, and it is suggested that by a system of thermal storage the heat voided by gas engines when running upon light and normal loads may be accumulated and used in a turbine to help over the peak.

The Scrap Habit

A noted English engineer on being asked what single feature of American shops most impressed him, replied: "The scrap heap." It is undoubtedly one characteristic of American practice to discard machinery as soon as it becomes out of date or inefficient, without much regard to its physical condition. The Englishman is economical of material and less so of labor. Here it is the labor that counts and, until recently, material has received scant courtesy.

It is not, however, of this phase that we wish to speak, but of individual economies, of private scrap heaps.

The corporation may scrap valuable machinery and the superintendent in his official capacity may approve of it, but the individual in his private life still retains traits of frugality and economy which have come down to him from his Puritan ancestry. When a man is living in a log cabin in the wilderness, he naturally saves every scrap of leather, every bit of iron, for he does not know when or where he may get others; and in the old-fashioned country villages with every man his own tinker, similar customs prevailed.

A recent issue of one of the standard magazines contains an article in which a well-to-do business man is represented as jumping from his carriage to pick up a new brick by the wayside and as saying that he gets enough bricks in this way to save a large part of the expense of repairs about his premises. He furthermore intimates that even if he has no use for the brick, he hates to see good material wasted. None but a rich man, whose time has ceased to have a market value, can afford to get his brick in this way. No, this is not economy, it is just the old Puritan habit of collecting and saving everything in one's path, whether useful or useless, a miser's instinct. The man just mentioned might, with as good reasons, have extended his drive to the railroad yards and picked up fragments of coal, thereby reducing the heating bill at his residence.

One who is constantly picking up scraps of leather, brass and iron, old hinges, bolts, nuts or pieces of pipe, usually has his labor for his pains. The stuff is never used and gradually accumulates in the attic or cellar, on the bench or under it until the would-be owner gets desperate and throws it all away. The argument used to be: "Save it, for you never know when you may want to use it." The argument should be: "If you never know when you may want to use it, don't save it."

There is a reasonable excuse at the house for saving twine and wrapping paper, for experience has taught that there is always use for them. In the engine room, nuts and bolts, pipe fittings and pieces of brass or leather may have future value. If saved, each should have its pigeon-hole or compartment, where it can be found when wanted.

A miscellaneous collection of junk, such as is found in some engine rooms, is wasteful rather than economical and should be disposed of to Tony or Isaac for what he will give.

Experience is a good teacher in this matter; in each particular vocation—the man-at-home, the superintendent or the engineer, has learned by experience that certain things are in demand and always find use; such things can well be saved.

Shall I keep this stove bolt and nut? Yes, I do use one occasionally and it may save a trip to the store.

Shall I keep this cast-iron bracket? I never did have a use for one and I do not know that I ever shall. No, better throw it away than to litter up your bench or floor "on suspicion."

The writer speaks feelingly on this subject for he has had the habit in its worst form. Repeated cleanings of attics and sheds and boxes and barrels have finally convinced him that much scrap means weariness and vexation of spirit and he has reformed. He does not pick up pins or bent nails or bricks; he passes by on the other side and leaves them to the Good Samaritan who has a carriage with which to haul them home.

The rusty hinge and the old bolt have no further attractions. He does not even save a piece of string unless he sees in the immediate future a use for that particular kind of string. He has more time available, he enjoys walks abroad and has no longer the terrifying prospect of an attic or a cellar crowded and disfigured with miscellaneous junk.

Apparent Efficiency

Just now we are hearing a lot about efficiency; the salesmen have taken it up as their slogan and even the daily newspapers have begun preaching it, since the recent claim of a certain Bostonian to the effect that he could save the railroads of this country a million dollars a day by introducing more efficient methods. Ostensibly, efficiency is the goal to be aimed at in all fields of activity, whether railroading, power generation or purely commercial enterprises, but in every case the meaning of the term "efficiency" in its broadest sense—the relation of useful result to effort—should be kept in mind. Too often only one phase of the problem is considered and "apparent" efficiency is attained at a sacrifice in economy. This is illustrated more particularly in the generation of power where the installation of a certain piece of apparatus may effect a saving of three or four per cent. in energy between the grates and the switchboard; yet its first cost and the cost of maintenance may more than offset the saving in energy.

It has been estimated that, excluding special cases, the cost of power in a manufacturing establishment amounts to from two to four per cent. of the cost of producing the manufactured article. Hence a piece of apparatus effecting a saving of three per cent. in the production of power would save only twelve-hundredths of one per cent. on the cost of manufacture, which slight gain might not warrant the extra investment. It is always well in such cases to carefully consider economy as well as efficiency before passing snap judgment.

It is a good thing to know that a steam line is thoroughly drained. Water has a habit of smashing things if, while traveling at high velocity, it is brought to a sudden stop.

Some engineers can tell you all about the horses and sporting events generally but when it comes to intelligently explaining the why of the simplest things in the engine room, they are all at sea.

A nonreturn valve in a steam main may never pay for the cost of the paint on the outside, but if a pipe or fitting should burst, there are great possibilities that it will pay for itself a hundred times over in preventing loss of life and damage to property.

Have you ever noticed how reckless the man in charge sometimes is when it is necessary for him to personally work with his hands? He should be the man to set an example to others of being careful.

According to their talk, some men can do anything, but when put to the test they cannot do even a third-class job without help.

Have you noticed how some engineers, repairmen and others leave everything to the last minute and have to stay on and finish after shutdown when the repairs could have been made just as well during the day?

You know that there are always some men who can run your plant far better than you are doing it.

A small trouble neglected will often cause a big shutdown.

Not much use throwing coal into a furnace while the safety valve is blowing.

An engineer cannot get experience for nothing; it must be paid for.

Reduction Gear for D.C. Generator

A multistage turbine running at three thousand six-hundred revolutions per minute, driving a direct current generator through a seven to one single reduction gear.

Heretofore, the steam turbine in large sizes has found application only in driving alternators and in the propulsion of ships, very little progress having been made in adapting it for driving direct-current or other machinery of moderate speed. High speeds applied to direct-current generators involve serious commutator troubles and structural difficulties, and it is conceded by most designers that the speed of 1000-kilowatt machines should not exceed 600 revolutions per minute and this speed has, in fact, been found most suitable for smaller machines even down to 500 kilowatts.

This speed, however, is entirely too low for the ordinary turbine. The speed of a turbine may be reduced in two ways: First, by increasing the diameter of the rotor, and, second, by increasing the number of stages. To accommodate it to the speed of a direct-current generator would necessitate a rotor of such a diameter as to seriously affect its strength; on the other hand, this speed would require such a large number of stages as to make the machine unusually long and thus introduce other difficulties and losses. The alternative then is to introduce reduction gearing between the turbine and the generator.

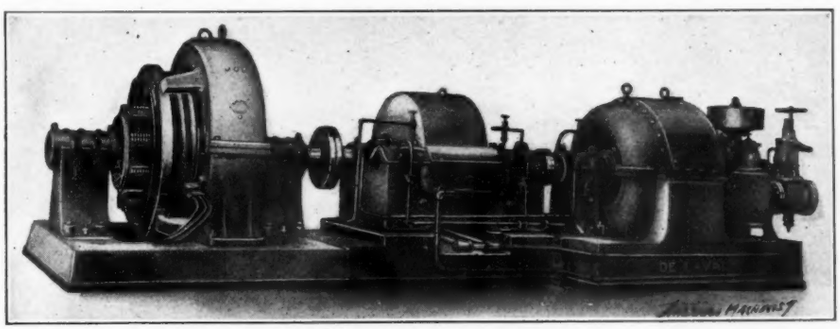


FIG. 1. TURBO-GENERATOR COMPLETE

The De Laval Steam Turbine Company for a number of years has employed single and double helical reduction gears on its small- and large-sized single-stage machines, respectively; the latter, however, driving only alternators or high-speed pumps. But only recently have they applied the single-helical gear to the multi-stage turbine for driving a direct-current generator of large size.

This unit, which is shown in Fig. 1, consists of a four-stage turbine driving a 500-kilowatt direct-current Crocker-Wheeler generator through a pinion and single gear, the speed of the turbine shaft being 3600 revolutions per minute and that of the generator 500 revolutions per minute, making the reduction ratio over 7 to 1.

The main casing, which is of cast iron, is nearly cylindrical in shape, being split horizontally so that the top half may be lifted off to give access to the revolving and stationary members of the turbine. The casing is supported on a level with the center of the shaft by two pedestals rising from the bedplate, one on each side, and is bolted down only at one end, thus permitting expansion and contraction in an axial direction between steel guides. As the endwise position of the shaft is also determined by a thrust bearing at the same end, the results of axial expansion are largely compensated for.

Steam is admitted to the turbine first through a strainer case and then through a combined trip and throttle valve, shown in Fig. 2; next through the adjacent governor valve and, after passing through steam nozzles, impinges upon the blades of the first-stage wheel. Partial admission is used in the first stage, and full admission in the succeeding stages. The wheels are of the standard De Laval type, and as a protection against flying pieces of metal in case a wheel should break, it is completely surrounded by a heavy steel band.

The governing mechanism, which is also shown in Fig. 2, is in duplicate, that is, there is a speed-regulating governor and a speed-limiting or emergency governor. The former is mounted at the top of a vertical shaft and is driven by a worm gear from the turbine shaft. It controls the movement of a vertical double-seated poppet valve similar to that used on standard De Laval turbines. The lower end of the governor shaft is connected to an oil pump which supplies the bearings of the machine and the pinion and gear. The emergency governor is located at the end of the turbine shaft and is ordinarily not in contact with the trip. Upon touching the latter, however, steam pressure is at once released from under a piston, by means of which a toggle gear is released, allowing the combined trip and throttle valve to close under the pressure of the steam in the supply pipe.

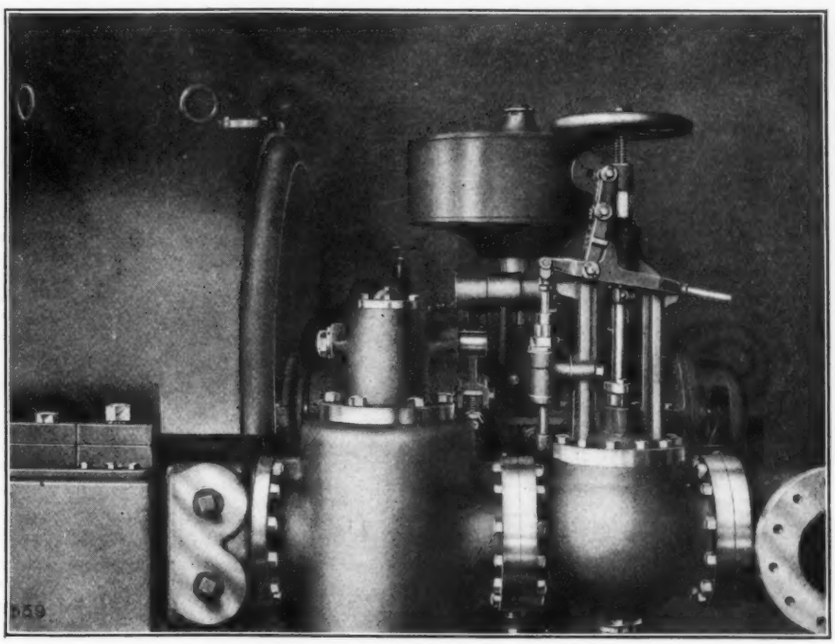


FIG. 2. GOVERNOR AND TRIP VALVE

The pinion and gear are shown in Fig. 3. The gear is of the double-helical or herring-bone type, differing from the standard gears supplied with De Laval turbines only in size and the fact that a single gear is used for large capacities. The pinion is cut from a solid bar of steel and is carried in plain babbitted bearings supported in a rigid cast-iron frame, which also supports the gear bearings. The pinion bearings are lubricated by sight-feed oilers from the pump system, the excess oil overflowing to the wells of the gear bearings, which are ring oiled. The gear consists of a solid cast-iron center upon which are shrunk two thick steel rings, and the hub is mounted on a stiff shaft, which carries at one end half of the flexible coupling for connection to the driven machine. The lubrication of the gear and pinion teeth is accomplished by jets of oil directed at the line of contact on the entering side. This oil after use is passed through an oil strainer located in the base of the turbine, then through a cooling and settling chamber and finally to the oil well, from which it is again pumped through the circuit. Temperature measurements taken after the machine had been running for several hours showed a difference of four degrees between the oil entering the gear case and that leaving the case.

The operation of the turbo-generator is remarkably free from vibration and noise and as it stands in the test room, supported upon small screw jacks without other means of support, it is hard to tell at a distance of a few yards whether or not the turbine is running without noting the moving parts.

It might be mentioned in passing that the determination of the efficiency of such gears within reasonable limits of accuracy is a comparatively simple matter and does not require the use of cumbersome and expensive hydraulic brakes or similar mechanisms. That is, since all energy lost in friction in the gear must be converted into heat, the measurement of the heat emanating from the gear case will give an accurate measure of the loss of energy in the gears. Such measurement of the heat is not difficult. The radiation from the casing can be determined accurately for any given temperature by observing either the rate of cooling under fixed conditions or by keeping the casing warm by means of hot water or steam. The amount of heat removed from the gears by the lubricating oil is even more easily determined by measuring the inlet and outlet temperatures and the weight of oil used per minute or per hour.

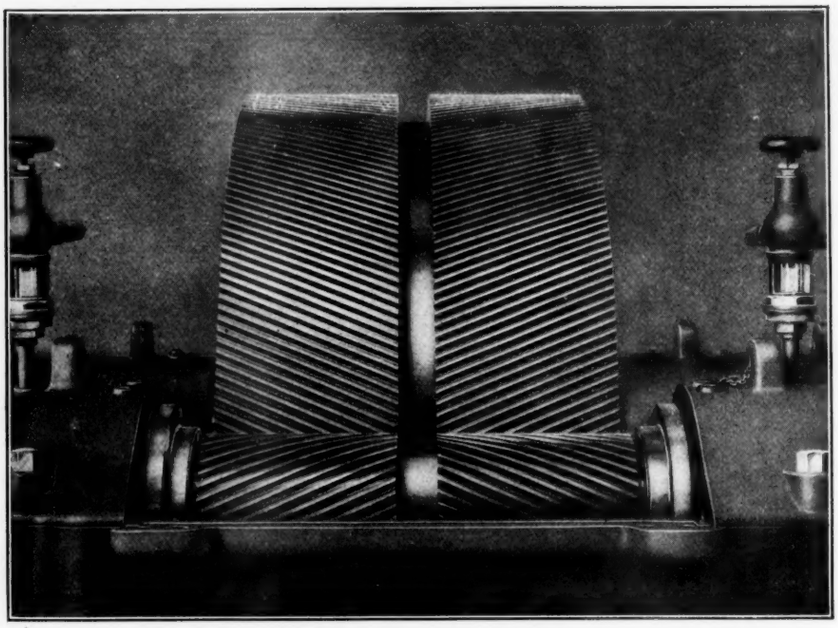


FIG. 3. PINION AND GEAR

Blank Flange Bursts with Fatal Results

As a result of water hammer, a cast-iron blank flange on a tee in a 20-inch live-steam pipe at the new power plant of the Amoskeag Manufacturing Company, Manchester, N. H., fractured early Monday morning, March 27, causing the death of three men.

This 20-inch pipe runs the entire length of the 500-foot boiler room to the pump room, where it drops down to the basement under the turbine room. There are two 20-inch pipes, one supplying steam to two turbines, the other delivering steam to what is known as the Langdon mill.

Just inside of the basement wall under the turbine room the pipe running to the Langdon mill has a steel-riveted tee connection, put in so that the side outlet faces lengthwise of the basement, as shown in the illustration. This tee is constructed of ⅜-inch steel and has a ½-inch thick flange. The blank flange was made of 1-inch cast iron, ribbed on the outside. It was this flange that fractured, a V-shaped piece being blown from the solid section, as shown.

The fracture by water hammer of a blank cast-iron flange on the side outlet of a 20-inch tee in a live-steam line in the Amoskeag Mills, causes the death of three men. The pipe had a pitch of 20 inches in 500 feet and was drained by a trap. The damage to the plant was confined to the blank flange.

This particular tee was put in place when the pipe line was constructed to provide an outlet connection for another pipe line when desired.

The accident occurred just at the time the engineer of the Langdon mill was getting his reciprocating engine up to speed for the day's run. Two shocks of water hammer were felt by men employed at the far end of the boiler rooms; these were followed by a third and more severe shock, which was immediately followed by a roar, as the steam in the 20-inch main, fed by 16 boilers, rushed through the opening in the fractured flange.

Engineer Pettigrew and Electrician Webster escaped without serious injury. As soon as Pettigrew heard the roar and saw the steam coming up through the cracks in the temporary plank flooring, he made his way through the steam to the door leading into the pump room and on into the boiler room where the steam was shut off. Webster, on his way past the one turbine that was in operation at the time, pulled the automatic which shut the unit down and probably prevented serious damage to the electrical end from running with a load while moist vapor filled the room.

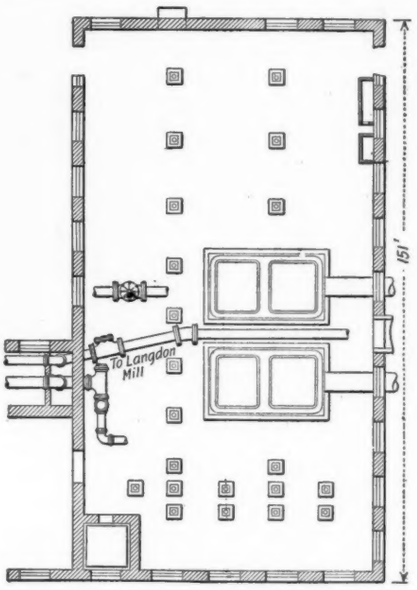
A steam pressure of 170 pounds per square inch was carried on the pipe, and before the flow had been gotten under control, one man was dead, two so severely burned that they have since died and

several others were burned, but not dangerously so.

Horace Crawford, an electrician, was so badly scalded that he died in a few hours. He had been at work all night and at the time of the accident had some wire in his hand. Later a window was found broken and the wire was on the outside, but evidently Crawford became confused and attempted to find another means of exit. When found he was on the floor near the double door at the end of the turbine room.

James Cassidy, a piper's helper, was found dead on the floor near where he had been last seen crossing the room. He was enveloped in steam which came up through the loose flooring. It is supposed that he inhaled steam, and immediately succumbed.

Frank Dyer, 18 years old, the last to die, was the son of Engineer Dyer, also



SHOWING LOCATION OF TEE AND NATURE OF THE FRACTURE IN THE BLANK FLANGE

seriously burned. He was just about to begin work during his Easter school vacation in order to gain experience in engineering. He had gone down into the basement to enter the wash room that was located on the opposite side of the basement from the tee connection and near the far end. He was just about to open the wash-room door (the key was later found in the lock), when the accident occurred. With rare presence of mind, Dyer ran around the end of the wash room and, opening a window that faced a dry raceway, dropped a distance of 20 feet, ran across the raceway, climbed up a ladder and jumped into a canal, doubtless to relieve his suffering. The burns and the shock of the ice-cold canal water was more than his system could withstand.

The only damage to the plant was the rupture of the blank flange. The fractured flange showed no indication of a flaw or other weakness. A new 5/8-inch steel blank flange, bumped to a radius equal to that of the diameter of the pipe, has been riveted to the dead end of the tee in place of the cast-iron blank flange.

Just why water hammer should have occurred is not known. The pipe was drained by a trap and Engineer Dyer had gone down to ascertain if a new trap that had been put in place the Sunday before was working properly. As it was, he left the basement just before the flange fractured. The steam pipe has a 20-inch pitch toward the discharge end.

Contrary to the accounts published by the daily papers, concerning the secrecy maintained by the officials of the company regarding the accident, it is but just to state that such reports were false. A POWER representative received most courteous treatment while investigating the accident and every question was freely answered.

Water Rights in California

An important decision regarding water rights for power and irrigation purposes in California has been handed down by Judge Hutton, of the superior court, Los Angeles. It distinguishes between the rights of private appropriators and the rights of riparian owners, the case at issue involving the right of the use of a 10-inch stream known as Garden Gulch creek, both parties relying on claims to prior appropriation.

On this subject, Judge Hutton rules: "It is a great mistake to assume that the waters of a stream under these conditions are the subject of appropriation. The only waters that may be appropriated are the waters of streams on Government land and this before the rights of settlers upon the stream, who, by reason of their settlement become riparian proprietors, have accrued.

"The system of riparian rights is in full effect in California, that is to say, that the riparian owner, as against all other classes of appropriators, has a right to the full flood of the stream, undiminished in quantity and unaffected in quality, except that each riparian proprietor may divert so much of the stream upon his riparian or bank land for irrigation purposes as he can put to economical, beneficial use. From the date that the rights of the settler attach to the land no appropriation can be made that will interfere with his riparian rights. His riparian rights are just as much a part of the land as the trees upon it, and unless taken away before the settler's rights accrue, he must be left in the enjoyment thereof unmolested. The evidence discloses that the plaintiff (the upper riparian owner) is threatening to take water, not from the stream proper, but from a nearby spring which obviously must either feed or be fed from the stream, and belongs in the watershed. Plaintiff has no right to carry his threats into execution and to remove all or any part of this water from the watershed. He cannot, even temporarily, do this without the consent of defendant (lower riparian owner)."

This defining shows conclusively upon what waters appropriations may be filed, and the extent of the appropriator's power of diversion.

Pressure Tank for Sprinkler System Explodes

BY EDWARD T. BINNS

On March 14, the pressure tank for the sprinkler system at the old Press building, Pittsburg, exploded. Considerable damage was done to the property and three persons were seriously injured. The tank was 72 inches in diameter and 21 feet long. It was made up of three 86-inch sheets 3/8 of an inch thick. The seams were triple-riveted lap joints, 7/8-

RUPTURED HEAD OF AIR TANK

inch rivets being used on a 3-inch pitch. The heads were made of 1 1/2-inch plate and were not braced.

There was no safety valve or pressure regulator on the tank, the pressure being regulated by the engineer in the engine room. The tank was located on top of the house. The boiler pressure carried was 90 pounds, and a duplex pump with a ratio of two to one was used to pump up the pressure in the tank. Some idea of the force of the explosion may be gained from the fact that one of the heads was blown out and driven broadsidewise through the wall of the building. It lodged under the floor of the adjoining apartment, bending five 5x9-inch steel I-beams. Several fragments of metal and piping were blown clear through the main building and out onto Fifth avenue, a distance of 500 feet. The body of the tank was wrenched loose from its moorings, shoved about 20 feet along the roof, stopping with several feet of its length projecting over the street, where hundreds of people pass constantly.

New Power House Equipment

What the inventor and the manufacturer are doing to save time and money in the engine room and power house. Engine room news

Vater System of Water Purification

This can be briefly described as a hot-process water-purifying system which takes advantage of the well known fact that chemical reactions are much more rapid and complete when they take place at high than at low temperatures. The system depends essentially on three fundamental propositions. First, the use of solutions of uniform strength; second, feeding in proportion to the load, and, third, plenty of time for the reactions to take place.

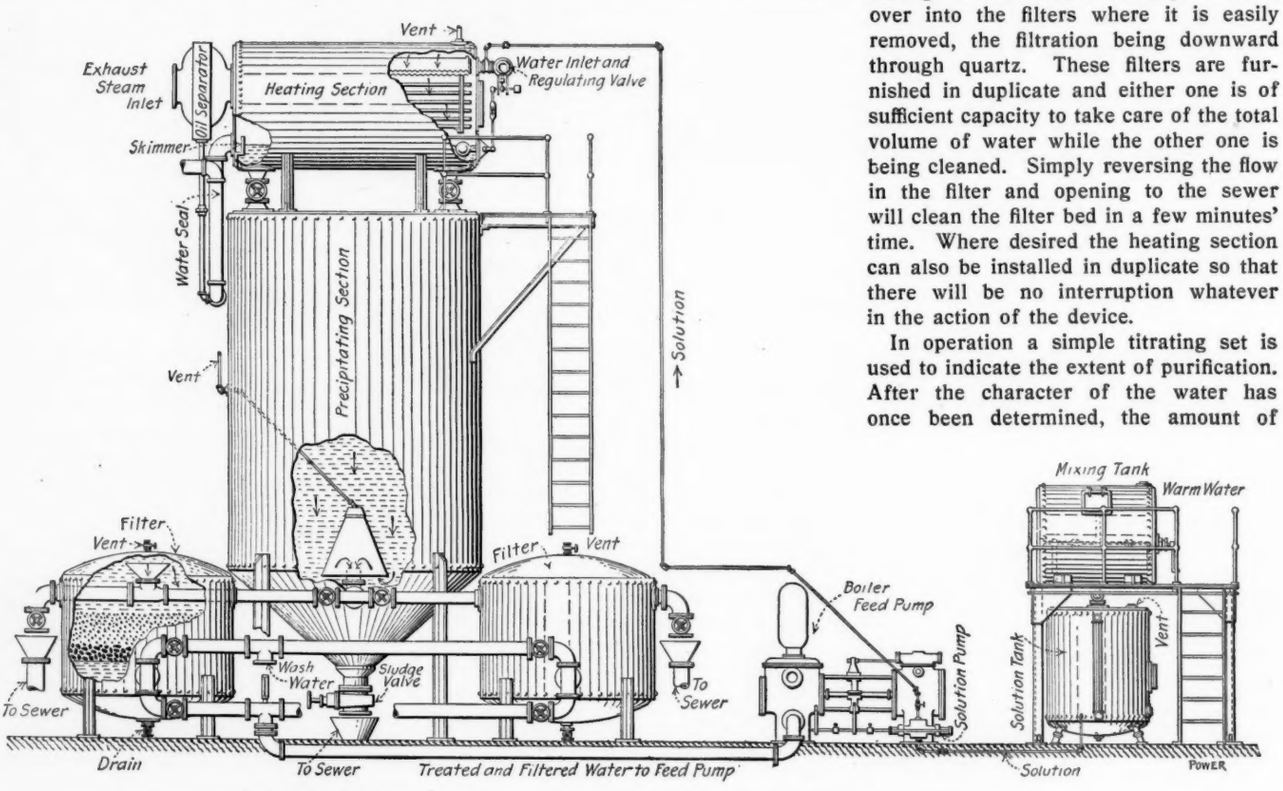
A mixing tank with paddles and crank for hand operation is provided, as shown in the part-sectional illustration. Here the reagents are mixed in the proportion indicated by the character of the water. After the mixing has been done and the solution has settled and clarified it is siphoned into the holding tank below, from which point it is taken by a special solution pump attached to the crosshead of the boiler-feed pump and delivered to the purifier proper. The solution pump is specially designed for this purpose, with a variable stroke which can be adjusted while the pump is in operation and provision is made to withstand the action of the reagents on its working parts. By providing a mixing tank and solution tank as shown, continuous runs can be made, the effect of the two tanks being the same as if this piece of apparatus were provided in duplicate.

The purifier proper consists, first, of a heating section, which is an induction open heater, in which is arranged a system of pans designed to break up the water into small particles and facilitate the transmission of heat, and, second, a precipitating tank. An oil separator is connected to the heater, which removes any oil that may be in the steam and allows the condensed steam to form part of the treated water.

A float valve control is arranged in the heater, maintaining the water level at the desired point, and two valved connections are arranged for the water to descend into the precipitating section. As the solution pump is connected to the feed pump, just the amount necessary for softening the water being used is introduced into the heater, where it is raised to exhaust-steam temperature and intimately mixed with the water before entering the precipitating tank.

The latter has been designed to give ample time for the reactions to take place. It is found that 90 per cent. of the impurities are precipitated at this point in the form of a sludge which can be blown out from the cone-shaped bottom of the tank. The light, flocculent material passes through the inverted cone-shaped intake, over into the filters where it is easily removed, the filtration being downward through quartz. These filters are furnished in duplicate and either one is of sufficient capacity to take care of the total volume of water while the other one is being cleaned. Simply reversing the flow in the filter and opening to the sewer will clean the filter bed in a few minutes' time. Where desired the heating section can also be installed in duplicate so that there will be no interruption whatever in the action of the device.

In operation a simple titrating set is used to indicate the extent of purification. After the character of the water has once been determined, the amount of color given to a test sample when titrated is a correct indication of the condition of the purified water. The operator is given a small bottle of water properly colored and he uses this as a guide when making up his solution. If he finds on titrating a sample that he has mixed a solution



SHOWING ARRANGEMENT OF THE VATER SYSTEM OF WATER PURIFICATION

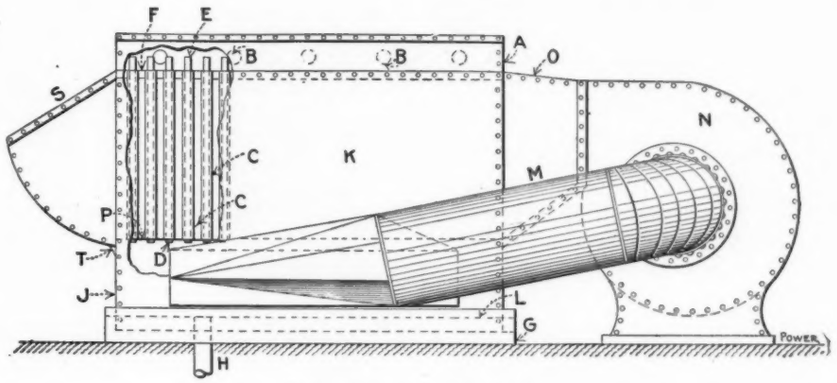
which is too strong, or, in other words, if the result of his test shows too much color in the sample, he simply reduces the stroke of the solution pump so as to feed the solution in less quantities. Similarly, if he finds the solution weak he can increase the stroke of the pump to compensate for this weakness.

It is claimed that the apparatus will reduce the incrusting solids to as low as 1½ grains per gallon, with an excess of solution not exceeding ¾ grain per gallon. Any combination of reagents can be used without making alterations in the equipment and the water is delivered to the boilers at a high temperature, thus doing away with the necessity for a feed-water heater where a softener is installed.

The Vater water-softening system is built by the Power Plant Specialty Company, Monadnock block, Chicago, Ill.

A Liquid Cooler

The accompanying illustration represents a liquid cooler that has been designed for the purpose of cooling liquids, such as condenser water from ammonia coils.



DETAILS OF LIQUID COOLER

The cooler consists of a blower and a bank of double cooling tubes inclosed in a sheet-iron casing. The liquid to be cooled flows through a header (not shown) and is distributed over the pan *A* by the short pipe connections *B B;* it then takes a downward course through the bank of tubes, between the tubes *C C* and *D D*. *E*, it will be noticed, is only an extension of the tubes *D*, bringing the top of the tubes far enough above the tube sheet *F* to prevent the liquid from flowing over the top into the center of the tubes *D D*, thus producing a hollow column of liquid.

The lower ends of the tubes *D* are expanded just large enough to pass snugly forming a seal for the purpose of keeping the air drawn downward through the tubes *D* and to prevent the outer air entering the suction pipe *M* of the blower *N* and destroying the vacuum thus created.

The air is then discharged back through the connection *O* into the chamber around the outer tubes *C* and between the upper and lower tube sheets *P* and *F* and finally is discharged out of the cooler through the connection *S*.

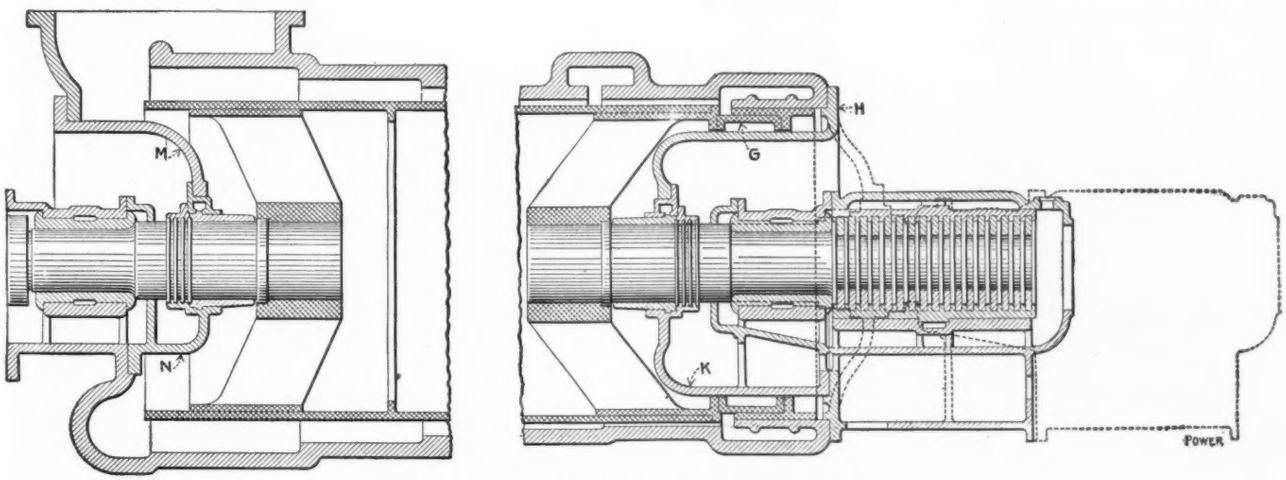
The water which is carried over with the blast of air through the cooler is allowed to drain back through the opening at *T;* thus none of the liquid is wasted but is all finally carried back to the tank through the larger tubes *C*, thus making a regulating valve of each set of tubes so the flow of liquid can be controlled, as the time taken by the passage of the liquid through the tubes plays an important part in the final temperature. The liquid is then received into the tank *G*, the level of which is maintained by the hight of the top of the return pipe *H* through which the liquid is returned to the point it came from as hot liquid to again do its mission as a cooling agent.

The extension *J* at the bottom of the casing *K* drops below the liquid line *L* maintained by the top of the pipe *H*, this being necessary to prevent the air from being drawn back through the pipe *H* instead of the liquid. *G*. The temperature of the liquid can be lowered from 100 degrees to about 50 degrees in summer weather, it is stated. The cleaning of any sediment or deposit that is common in an equipment of this kind can be easily removed at any time without stopping the cooler at all, on account of the arrangement of the tubing.

New Parsons Turbine Casing

When the turbine casing is made in halves, with the ends cast on, the end or head cannot project inside of the rotor drum, as it would not allow the latter to be lifted out; nor indeed to be inserted. A British patent has just been issued to the Hon. Charles A. Parsons for a casing of which the form illustrated herewith in an example.

The cut shows the casing, parted longitudinally at the center as usual, but with the heads cast in the four separate pieces *H K* and *M N*. The rotor *G*, including the driving pistons, extends well over the head, but the latter can be unbolted and removed in sections, the under halves being turned around the shaft and lifted out like the lower boxes of a bearing. Were the heads cast integral with the rest of the casing the bearing and thrust block would extend at least to the dotted position, greatly increasing the length and weight of the turbine, and the difficulties which go with a long rotating member.



NEW TYPE OF CASING FOR PARSONS TURBINE

The adjustment of the flow of the liquid is accomplished by a lever (not shown) which, by a movement either up or down, increases or diminishes the flow of the liquid through the inner tubes *D*.

The only additional water used is the water with which the air is sprayed—this makes it possible to reach a low temperature during the hot and sultry days of summer. This spray is at the top, over the pan *A*, and is not lost as it unites with the water being circulated through the cooler.

This device is made by F. P. Hopkins, 1361 Bonnie View avenue, Lakewood, O.

New Era Self Lubricating Metallic Packing

The packing shown herewith is an improved product, which, consisting of a nonelastic, compound mass of metallic lubricants, requires no lubrication whatever except that contained within its own substance. It is claimed by the manufacturer that it never becomes charred or otherwise unfit for service and that it will not lock or score the rods, plungers, or shafts on which it is used. Fig. 1 is a sectional view of the packing in place, as manufactured by the New Era Manufacturing Company, Kalamazoo, Mich. *A* represents the piston rod; *B* the body or stuffing box; *C* the stuffing-box gland; *D* the main body of packing container; *E* the supplementary gland; *F F* the bearing rings; *I I* the self-lubricating metallic packing, and *J* the metallic rings which surround the rod in three sections, as illustrated in Fig. 2.

The bearing rings *F F* admit lateral motion to the main body of the packing container *D*, and supplementary gland *E*, to compensate for any movement of the piston rod when out of alinement.

As shown in Fig. 2, there are three metallic packing rings surrounding the rod, the space between their ends being occupied by the plastic packing *I*. This latter may be renewed whenever necessary and serves to take up wear on the packing as it occurs. It can be placed on an engine without dismantling and when occasion requires.

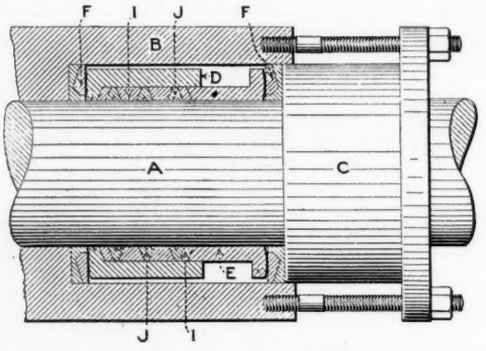
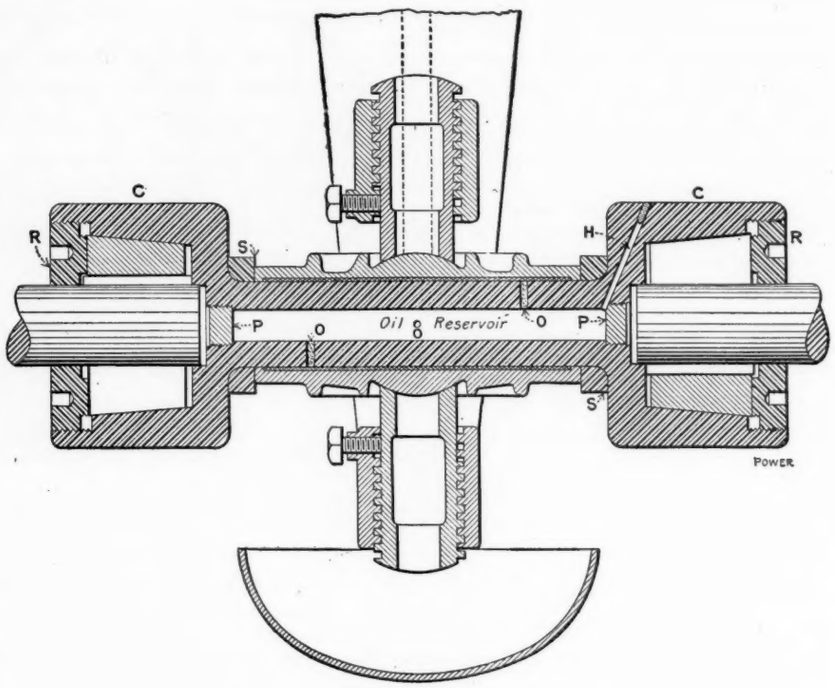


FIG. 1. SECTIONAL VIEW OF PACKING CONTAINER

A Self Oiling Hanger Coupling

In the accompanying drawing is shown a self-oiling hanger coupling, the object of which is to connect two sections of a line shaft at a hanger, thus providing more space on the shaft for pulleys. It is made with a reservoir for holding lubricating oil that is fed to the bearing through the oil holes *O*, which are fitted with felt to prevent the oil from flowing too rapidly.



COMBINATION HANGER AND COUPLING

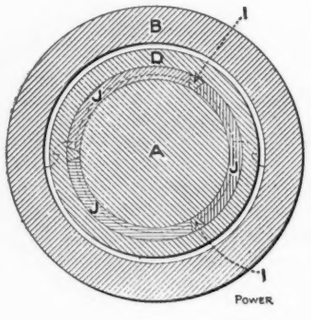


FIG. 2. TRANSVERSE SECTION

This style of coupling supports the shaft at its weakest point. The coupling can be used on any standard hanger and can be made with or without the oiling device.

It consists of a steel forging *C*, which is turned in the center to form the journal, and has the cone cups on each end to receive the ends of the two sections of shafting to be coupled together. The cones are forced in by the threaded rings *R* with a spanner.

The split rings *S* are used to take up the lateral play of the shaft.

In making the oiler for the coupling, a hole is drilled through its entire length and the ends are closed by the cast-iron plugs *P*. To fill the reservoir the passage *H* is drilled from the outside, and the outer end plugged by a tight-fitting screw.

This hanger is the invention of H. C. Williamson, 309 London street, Portsmouth, Va.

Coal Land Frauds

It was reported on March 28 that Charles F. Munday, a lawyer of Seattle, Wash., was placed on trial in the Federal court on a charge of having conspired to defraud the Government of $100,000,000 coal lands near Katalla, Alaska. He and Earl E. Stacey, private secretary to the late M. J. Heney, builder of the White Pass & Copper River and Northwestern railroads, the latter the property of the Morgan-Guggenheim syndicate, and Archie W. Shields were indicted by a Federal grand jury sitting at Tacoma last October.

Generally, the indictments charge Munday and his associates with having several years ago induced dummy locators to file on the claims best known as the English group for the Alaska Development Company and the Pacific Coal Company. These claims comprise 6087 acres of what is declared by experts to be among the richest coal lands in Alaska.

Notice!

Paul Kirk, who formerly represented POWER as a subscription solicitor in New York City, is no longer in the employ of this paper.

Large Plant Taken Over by Central Station

It is reported in the daily press that the Walworth Manufacturing Company has signed a five-year contract with the Edison Electric Illuminating Company, of Boston, for all the light and power service in its big manufacturing plant in South Boston. The contract calls for service to replace five steam plants aggregating a total of 1100 horsepower capacity. The business of the Walworth company has increased to the point where the management was confronted with the necessity for a practically complete renewal of its steam-power system, the installation of an electric light and power plant of its own or the adoption of the service of the Edison company, and the central station won out.

Central Station Welfare Work

The public-policy committee of the National Electric Light Association, which, during the past winter, has been devoting considerable attention to the various aspects of welfare work as related to the central-station industry, held a final meeting at the New York headquarters in the United Engineering building on March 28, when the report which has been prepared through a series of long conferences was unanimously adopted, and the recommendations and suggestions were put in definite shape for presentation to the member companies, in number nearly a thousand, at the annual convention in New York next May.

Several of the companies already have in force some of the schemes proposed, but it is not assumed that every company will wish to adopt every form of relationship outlined in the report. The plan includes accident insurance, sickness insurance and death benefits, service annuities, profit-sharing, employees' savings and investment funds, and life insurance, although with regard to the last item it is suggested that the companies limit themselves to providing their employees with all possible information in connection with safe low-cost life insurance, and do not put in force any plan of their own.

The coming report will give in detail the methods by which provision can be made under each of the other heads. By unanimous vote the term "pension" has been dropped and the service annuity adopted as the recognition of an automatic recompense for continuous service, and the committee is of the opinion that member companies should provide such annuities for every male employee reaching the age of sixty-five, and every female employee of sixty years after continuous and satisfactory record of ten years of service. The details of profit sharing are based upon the idea that it is better to have those engaged in the industry as partners rather than employees and that preferably profits of the employee based upon his wage scale should reach him in the securities of his company and that dividends upon such securities should be paid in cash, in the manner customary with other security holders. Details are also given with regard to savings funds and investment funds, with the object of promoting thrift amongst employees and, where feasible, combining the plan with profit sharing, it having been found that the two work out very satisfactorily together.

The report will be awaited with interest by all connected with public utilities and by economists in general.

PERSONAL

John B. Youngblood, formerly State examiner for the Cleveland district, has been appointed assistant chief examiner with headquarters at Columbus, O. Thomas Eaton has been appointed to fill the vacancy left in the Cleveland district.

On April 1, James A. Donnelly, of New York City, addressed the Robert Fulton Assocation, Illinois No. 28, National Association of Stationary Engineers, in the rooms of the association in the Masonic Temple, Chicago. His subject was "Steam Circulation."

Robert Bosch, of Stuttgart, Germany, designer and inventor of the Bosch products, has arrived in the United States. Doctor Bosch is much interested in our great manufacturing industries, and with Otto Heins, president of the Bosch Magneto Company, of New York, is making an extended tour of the United States with the object of visiting some of the larger American industries as well as natural points of interest.

OBITUARY

George Bowers Caldwell, of Yonkers, N. Y., died, March 31, 1911. Mr. Caldwell was born at Lawrence, Mass., in 1863 and was for many years connected with the engineering department of Westinghouse, Church, Kerr & Co., as one of the chief mechanical engineers. Prior to his connection with this company he was employed for thirteen years in the machine shops of the Lawrence Manufacturing Company, of Lowell, Mass., and the Washington Mills Company, of Lawrence, Mass., also in charge of their new construction and repair work.

During his connection with Westinghouse, Church, Kerr & Co., which began in 1893, he was connected with the design and construction of the following important pieces of work:

The mechanical and electrical features of the South Terminal Station, Boston, Mass., the terminal station of the Pittsburg & Lake Erie Railroad, the railroad shops of the P. & L. E. R. R. at McKees Rocks; the construction of the Kingsbridge power station, New York City, for the Third Avenue Railroad. He also supervised the design and installation of the Long Island Railroad Company's electrification, including the large power house at Long Island City. His last work was in charge of design and construction of the mechanical and electrical features of the Pennsylvania terminal station in New York City, which he was obliged to relinquish just before it was completed.

Mr. Caldwell was a member of the American Society of Mechanical Engineers and the American Society of Civil Engineers. He was also a member of Grecian Lodge A. F. & A. M. and Mt. Sinai Chapter R. A. M., of Lawrence, Mass. He leaves a wife, four children and his father, Lewis H. Caldwell, the latter being a resident of Los Angeles, Cal.

SOCIETY NOTES

The board of governors of the American Society of Heating and Ventilating Engineers held a meeting at the headquarters of the society in the Engineering Societies building, 29 West Thirty-ninth street, on Friday afternoon, March 24. Twenty-five applications for membership were approved and ordered prepared for the usual membership ballot. It was voted to issue during the present year the proceedings for 1909 and 1910. The proposal to hold the summer meeting on a three days' steamship trip on June 27, 28 and 29 on Lake Michigan and Green bay was favorably received and it was decided to canvass the membership to learn if a sufficient number may be counted on. Tentative arrangements have been made to charter one of Lake Michigan's leading steamships. Special entertainment is planned for the three evenings taken up in the journey; proper periods of morning and afternoon are reserved for the technical sessions and a considerable number of stops at important cities and interesting places with perhaps an hour's sojourn in each case are possible.

NEW INVENTIONS

Printed copies of patents are furnished by the Patent Office at 5c. each. Address the Commissioner of Patents, Washington, D. C.

PRIME MOVERS

TUBE OR WAVE-OPERATED MOTOR. Christopher C. Atkinson, Hawkinsville, Ga. 987,685.

WAVE MOTOR. Jerome B. Norton, Roslindale, Mass. 987,842.

ELASTIC-FLUID TURBINE. Carl Richard Waller, Trenton, N. J., assignor to De Laval Steam Turbine Company, New York, N. Y., a Corporation of New Jersey. 987,842.

INTERNAL COMBUSTION ENGINE. Jamie Hunter Batchelor and Herbert H. Smith, Dothan, Ala. 987,848.

GAS ENGINE. John T. Cowie, New Westminster, British Columbia, Canada, assignor of one-half to Henry Schaake, New Westminster, Canada. 987,860.

ROTARY GAS ENGINE. Franklin D. Thomas, Saginaw, Mich. 987,929.

AUTOMATIC WAVE APPARATUS. Robert Max Mobius, San Diego, Cal. 988,012.

INTERNAL COMBUSTION ENGINE. Perry Okey, Columbus, Ohio, assignor of one-half to Sarah Louise Okey, Columbus, Ohio. 988,021.

TURBO DISPLACEMENT ENGINE. Lewis Hallock Nash, South Norwalk, Conn., assignor to Nash Engineering Company, a Corporation of New York. 988,133.

BALANCED WATER MOTOR. Philander T. Dodson, Creston, Iowa. 988,256.

INTERNAL COMBUSTION ENGINE. Geo. W. Brown, Salamonie township, Huntington county, Ind. 987,860.

BOILERS, FURNACES AND GAS PRODUCERS

MECHANICAL STOKER. Arthur R. Selden, Rochester, N. Y. 987,834.

FURNACE. Herman A. Poppenhusen, Evanston, and Joseph Harrington, Riverside, Ill. 987,911.

FURNACE. Herman A. Poppenhusen, Evanston, Ill. 988,027.

OIL BURNER. Ernest L. Kendall, Riggold, Tex. 988,111.

FURNACE. William McClave, Scranton, Penn., assignor to McClave-Brooks Company, Scranton, Penn., a Corporation of Pennsylvania. 988,123.

INJECTOR BURNER. Nicholas S. Sibert, Neodesha, Kan. 988,216.

FEED-WATER HEATER. Jared S. Sweeny and William W. Grindle, Decatur, Ill.

POWDERED-COAL BURNER. Alva D. Lee, Boston, Mass., assignor to Lee Furnace and Burner Company, a Corporation of New York. 988,271.

POWER PLANT AUXILIARIES AND APPLIANCES

BOILER SKIMMER. Byron Epson Foss, Chicago, Ill., assignor of forty-nine one-hundredths to Richard H. Malcomson, Chicago, Ill. 987,710.

ROTARY PUMP. Adelbert Fournier, Sprague, Wash., assignor to James F. O'Brien, Seattle, Wash. 987,711.

LUBRICATOR. George H. Menzies, Pittsburg, Penn. 987,735.

VALVE. John W. Smith and Elmer H. Smith, Minneapolis, Minn. 987,757.

INJECTOR. William Henry Stirling, St. John, N. B., Canada, assignor of one-half to James E. Hogan, St. John, N. B., Canada. 987,769.

ENGINE CROSSHEAD. Robert W. Bryan, Aberdeen, Wash., assignor of one-half to George B. Reid, Aberdeen, Wash. 987,853.

PUMP. Charles Williams, Brooklyn, N. Y. 987,934.

TURBINE PUMP. Walter L. Forward, West Berkeley, Cal., assignor to Byron Jackson Iron Works, Berkeley, Cal., a Corporation of California. 987,976.

BEADING TOOL FOR BOILER TUBES. Eugene Wiet, San Francisco, Cal. 988,054.

OILING DEVICE. George W. Cook, Jr., Bainbridge, N. Y., assignor to American Separator Company, Bainbridge, N. Y., a Corporation of New York. 988,080.

SEPARATOR FOR BOILERS. Joseph E. Harrison, Harvey, N. D. 988,264.

APPARATUS FOR PREPARING GROMETS OR PACKINGS FOR STUFFING BOXES. William Heron, Birkenhead, England. 988,267.

MECHANICAL MOVEMENT FOR AUTOMATIC STOKERS. William McClave, Scranton, Penn., assignor to McClave-Brooks Company, Scranton, Penn., a Corporation of Pennsylvania. 988,275.

ELECTRICAL INVENTIONS AND APPLICATIONS

ELECTRIC HIGH-WATER ALARM. Edwin E. Brackett, Central Falls, R. I. 987,694.

ALTERNATING-CURRENT MOTOR AND CONTROLLING DEVICE THEREFOR. Vance I. Gray, Toledo, Ohio, assignor to the F. Bissell Company, Toledo, Ohio, a Corporation of Ohio. 987,979.

ENGINEERING SOCIETIES

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Pres., Col. E. D. Meier; sec., Calvin W. Rice, Engineering Societies building, 29 West 39th St., New York. Monthly meetings in New York City. Spring meeting in Pittsburg, May 30 to June 2.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

Pres., Dugald C. Jackson; sec., Ralph W. Pope, 33 W. Thirty-ninth St., New York. Meetings monthly.

NATIONAL ELECTRIC LIGHT ASSOCIATION

Pres., Frank W. Frueauff; sec., T. C. Martin, 31 West Thirty-ninth St., New York. Next meeting in New York City, May 29 to June 2.

AMERICAN SOCIETY OF NAVAL ENGINEERS

Pres., Engineer-in-Chief Hutch I. Cone, U. S. N.; sec. and treas., Lieutenant Commander U. T. Holmes, U. S. N., Bureau of Steam Engineering, Navy Department, Washington, D. C.

AMERICAN BOILER MANUFACTURERS' ASSOCIATION

Pres., E. D. Meier, 11 Broadway, New York; sec., J. D. Farasey, cor. 37th St. and Erie Railroad, Cleveland, O. Next meeting to be held September, 1911, in Boston, Mass.

WESTERN SOCIETY OF ENGINEERS

Pres., O. P. Chamberlain; sec., J. H. Warder, 1735 Monadnock Block, Chicago, Ill. Meeting first Wednesday of each month.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA

Pres., Walter Riddle; sec., E. K. Hiles, Oliver building, Pittsburg, Penn. Meetings 1st and 3d Tuesdays.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Pres., R. P. Bolton; sec., W. W. Macon, 29 West Thirty-ninth street, New York City.

NATIONAL ASSOCIATION OF STATIONARY ENGINEERS

Pres., Carl S. Pearse, Denver, Colo.; sec., F. W. Raven, 325 Dearborn street, Chicago, Ill. Next convention, Cincinnati, Ohio, September 12-15, 1911.

AMERICAN ORDER OF STEAM ENGINEERS

Supr. Chief Engr., Frederick Markoe, Philadelphia, Pa.; Supr. Cor. Engr., William S. Wetzler, 753 N. Forty-fourth St., Philadelphia, Pa. Next meeting at Philadelphia, June 5-10, 1911.

NATIONAL MARINE ENGINEERS BENEFICIAL ASSOCIATIONS

Pres., William F. Yates, New York, N. Y.; sec., George A. Grubb, 1040 Dakin street, Chicago, Ill. Next meeting at Detroit, Mich., January 15-19, 1912.

INTERNAL COMBUSTION ENGINEERS' ASSOCIATION.

Pres., Arthur J. Frith; sec., Charles Kratsch, 416 W. Indiana St., Chicago. Meetings the second Friday in each month at Fraternity Halls, Chicago.

UNIVERSAL CRAFTSMEN COUNCIL OF ENGINEERS

Grand Worthy Chief, John Cope; sec., J. U. Bunce, Hotel Statler, Buffalo, N. Y. Next annual meeting in Philadelphia, Penn., week commencing Monday, August 7, 1911.

OHIO SOCIETY OF MECHANICAL ELECTRICAL AND STEAM ENGINEERS

Pres., O. F. Rabbe; acting sec., Charles P. Crowe, Ohio State University, Columbus, Ohio. Next meeting, Youngstown, Ohio, May 18 and 19, 1911.

INTERNATIONAL MASTER BOILER MAKERS' ASSOCIATION

Pres., A. N. Lucas; sec., Harry D. Vaught, 95 Liberty street, New York. Next meeting at Omaha, Neb., May 23-26, 1911.

INTERNATIONAL UNION OF STEAM ENGINEERS

Pres., Matt. Comerford; sec., J. G. Hannahan, Chicago, Ill. Next meeting at St. Paul, Minn., September, 1911.

NATIONAL DISTRICT HEATING ASSOCIATION

Pres., G. W. Wright, Baltimore, Md.; sec. and treas., D. L. Gaskill, Greenville, O.

BUSINESS ITEMS

"Boiler Room Tactics" is the title of a booklet, which has been issued to give some general rules for the care and management of the Heine boilers. The booklet contains a good deal of very useful information for those having this type of boiler in charge and will be sent on application to the Heine Safety Boiler Company, 2449 East Marcus avenue, St. Louis, Mo.

A 36-inch Swartwout horizontal oil separator was sold last month to the Holly Sugar Company, Huntington Beach, Cal., by the Ohio Blower Company, of Cleveland, Ohio. Other oil separators were sold to the Michigan Paper Company, Plainwell, Mich.; D. C. Armbrust, Los Angeles, Cal.; Ellwanger Barry Realty Company, Rochester, N. Y; M. D. Olds, Cheboygan, Mich., and Bachelor Timber Company, West Branch, Mich.

F. L. W. Saunderson has been appointed the Canadian manager of the Magnolia Metal Company, with factory and offices located in Montreal. Mr. Saunderson graduated at McGill University in class of 1891, taking a course in electrical engineering and afterward took a special practical electrical course with the Thomson-Houston Electric Company, and for the past fifteen years has been identified with the mill-supply business in Canada.

Persons having a liking for mechanical devices will be interested in an ingenious model, now being distributed by the Harrison Safety Boiler Works, Seventeenth and Clearfield streets, Philadelphia, Penn., to illustrate the valve-timing gear in the new Cochrane steam stack and cut-out valve feed-water heater and receiver. The model, which is constructed of stiff celluloid, illustrates neatly the fact that when the heater is cut off from the exhaust steam supply, the separator attached to and forming a part of the heater continues to furnish exhaust steam purified of oil to the heating or drying system, while the trap is cut off from communication with the heater, but still continues to drain the separator. Upon the reverse of the model it is stated that full particulars regarding the application of these heaters in connection with all kinds of exhaust steam-heating systems are fully explained in the "Exhaust Steam Heating Encyclopedia," published by the manufacturer, which, with the model, is sent gratis to persons who are interested in the design, installation or operation of exhaust-steam heating systems.

NEW EQUIPMENT

Brockton, Mass., is contemplating the installation of a municipal electric-lighting plant.

Ernest Marshall, Oakes, N. D., has been granted franchise to install an electric-light plant.

The Standard Ice Company, Seattle, Wash., is planning to erect a new boiler-house addition.

Troy Laundry, Hagerstown, Md., is in the market for a 125-horsepower return-tubular boiler.

The Ottawa (Ont.) Electric Railway Company will build an addition to its power house.

The Lowes Laundry, South Norwalk, Conn., is contemplating installing a 60-horsepower boiler.

The Preston Fertilizer Company, Laurel Hill, R. I., will install boiler, engine and pumps.

Power plant of the Milwaukee Electric Railway Company, at Racine, Wis., was burned.

The cities of Marshfield and North Bend, Ore., are planning a joint municipal water system.

Moments with the Ad. Editor

A department for subscribers edited by the advertising service department of Power

A FEW days ago one of our Service Department men sat in the office of a firm which was about to begin an advertising campaign on an article used in power plants.

The firm consisted of two men, father and son. The subject under discussion was what they wanted to say in their ads.

"Now, dad," said the junior partner, "I've thought a lot about this advertising game lately. What we want to do is to say something strong, something like: 'This device is the best ever made. It will do three times as much work as any other and last twice as long!'"

"But it won't, Tom," said the father. "You know it won't."

"Of course it won't," the son went on, "but it sounds good and it will get us business. I tell you I believe we've got to talk big—to paralyze the readers."

The father turned to the Service man, who had been listening. "What do you think about it?" he asked.

"I don't believe in paralysis," was the reply, "but where did you get your idea?" he asked the young man.

"Well," he said, "you are going to write our ads and you've got to have something to talk about. A little exaggeration will help you; besides the readers won't believe it all anyway. We've got to put it stronger than it really is to get any of it over. Look at the business Barnum used to get by exaggerating in his advertising. Of course, we'll leave it to you, but if people believe only half they hear, you've got to make the half that's left pretty convincing."

Whereat the Service man arose and took the floor.

"If these were the principles on which you manufacture your article," said he, "I wouldn't bother to argue with you, I couldn't write your ads, and you couldn't buy space in my paper. But I happen to know that your product is a good one, honestly made, and that your only trouble is a woeful misunderstanding of modern advertising.

"In the first place you are wrong when you think that the readers will not believe what you say. They will, because modern advertisers stand back of their ads as they do back of their goods.

"And so will you.

"The days of exaggeration are past—you can't sell bad goods with good advertising any more than you can sell good goods with bad advertising, and you can't sell either by exaggerated claims.

"Mr. Barnum succeeded because he was selling amusement and a part of the entertainment was the being stung. If he had been, or were now, selling fake shoes, or fake automobiles or fake engines there would be no laughs, no amusement and no business.

"And even if an advertiser today could get a fake ad printed and get a number of readers to start business dealings with him—then he would be like the fellow who killed the goose that laid the 18-karat eggs.

"It isn't the publishers alone who have taught the readers to believe what they read in the advertising pages—it's the advertisers, the manufacturers who have built up confidence by telling the truth in their ads."

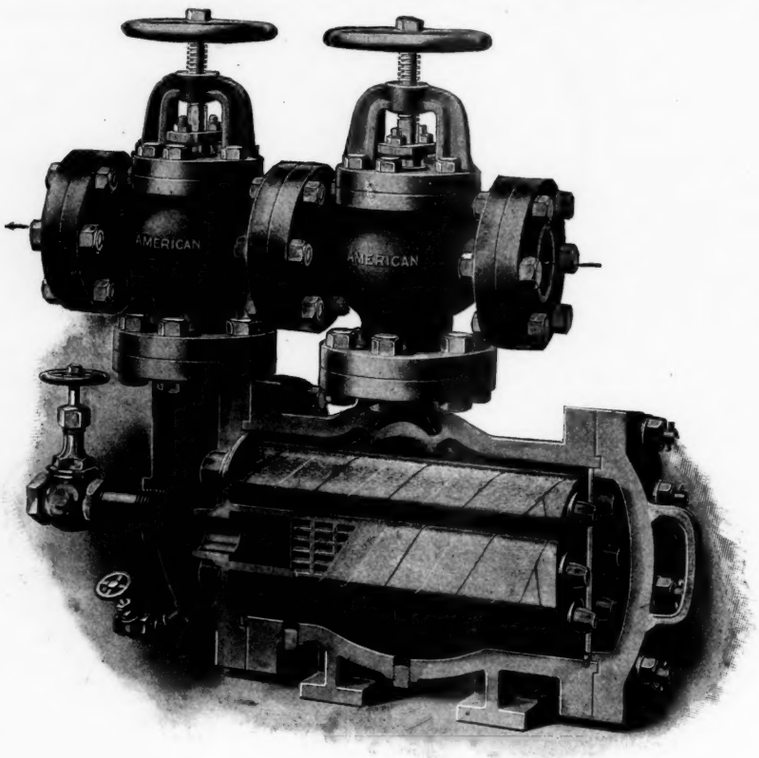
By now both father and son agreed with the Service man.

"To tell the truth," said the father, "is always best—it's the Sixth Commandment of Moses."

"It's the First and all the other Commandments of Advertising," replied the Service man. "In this enlightened age a manufacturer is known not by the company he keeps, but by the advertising he does.

"The warning is no longer, '*Caveat Emptor*—let the buyer beware,' but '*Caveat Advertiser*—let the advertiser beware!'"

American H_2O Grease Extracting Feed Water Filter



A necessity in every plant where condensation is used for boiler feed.

It removes all the oil and grease from the condensation permitting only pure water to enter the boiler.

Thus it prevents bagging due to oil caking on the boiler plates; it reduces boiler wear and tear; removes danger of accidents caused by bulging plates.

Filtering surface equal to 320 times the area of the feed water pipes.

Renewals very easy to make. Every part easy of access. First cost low—maintenance cost low.

Has a device for applying a reverse current of steam for temporary cleaning.

It makes fewer repairs necessary; increases the steaming capacity of the boiler; reduces coal requirements.

It takes up little room, is easy to clean, and is absolutely reliable.

Investigate—we will mail full details of the American H_2O Grease Extracting Feed Water Filter and our other steam specialties, on request.

American Steam Gauge & Valve Mfg. Company

Boston, Mass.

New York, 26 Cortlandt St. Atlanta, 525 Candler Bldg. Chicago, 130-132 Jefferson St. Pittsburg, Columbia Bank Bldg.
San Francisco, Monadnock Bldg. Montreal, 444 St. James St. Los Angeles, 213 So. Los Angeles St.

The Office Knows When You Save Expenses

The office knows when conditions in your department are improving, when you save coal, or repairs, when you are producing power at lower cost than previously. Because the office puts through the bills.

When the question of a raise for you comes up, the office has records of your ability which, you can be sure, are carefully taken into account.

Your record in the office will always show to your credit, if you own an

American-Thompson Indicator

(The only original J. W. Thompson Improved Indicator—all others are Imitations)

Price $55.00 $5.00 Down $5.00 Monthly

Because if you use your American-Thompson regularly you'll have no trouble in the cylinder, no leaky valves, no leaky piston, no steam waste.

The valves will always be properly adjusted, you'll know exactly what's going on *inside* the cylinder as well as outside.

Which knowledge will mean saving in coal, repairs, and wear and tear of the engine.

And with records like these in the office, you'll have all the proof you need when it comes to convincing the boss you deserve promotion.

$5.00 down brings the American-Thompson Indicator—$5.00 monthly pays the balance.

Besides you have the privilege of examining the outfit for 5 days.

Send your first payment ($5.00) today and start on the road to better things.

We'll ship your American-Thompson as soon as order is received, in a special mahogany case.

Mail the coupon before you do another thing—**NOW**

American Steam Gauge & Valve Mfg. Company
Boston, Mass.

New York Chicago Atlanta
Pittsburg San Francisco Los Angeles

MAIL COUPON FOR PROPOSITION No. 105

American Steam Gauge & Valve Mfg. Co.
Boston, Mass.

Send me full details of your Indicator Offer No. 105

Name . . . . . .
Address . . . . . .
City . . . . . State . . . .

HELP WANTED

Advertisements under this head are inserted for 25 cents per line. About six words make a line.

ENGINEERS WANTED to solicit for the Rolin patent adjustable grate. Apply Standard Grate Co., Heed Bldg., Philadelphia.

WANTED—Thoroughly competent steam specialty salesman; one that can sell high-grade goods. Address "M. M. Co.," POWER.

AN ENGINEER in each town to sell the best rocking grate for steam boilers. Write Martin Grate Co., 281 Dearborn Street, Chicago.

AGENTS WANTED for first-class steam specialty in use throughout United States. Address C. S. Wood, 410 S. 15th St., Philadelphia, Penn.

ENGINEER-SALESMAN wanted for our Chicago office. Schutte & Koerting Co., 12th & Thompson Sts., Philadelphia, 805 Security Bldg., Chicago.

WANTED—An engineer in each city as agent for a high class water-back Scotch boiler, the most economical steam generator known to the trade. Kingsford Foundry & Machine Works, Oswego, N. Y.

WANTED—An assistant engineer for general operating of packing plant, having 2500 horsepower ice machines, electric generators, motors, boilers and general repair work; references required. Address Box 416, POWER.

MECHANICAL ENGINEER for position that requires a theoretical and practical knowledge of heating, plumbing and sprinkler systems; would prefer a technically trained man; a position with good prospects; answer, giving details as to education, past experience and connection, to Dept. 1056, Western Electric Company, Chicago.

MISCELLANEOUS

Advertisements under this head are inserted for 25 cents per line. About six words make a line.

SEND 50c. for a superior metal polish formula. Geo. R. Williams, 329 E. Hardin St., Findlay, Ohio.

PATENTS. C. L. Parker, Patent Attorney, ex-examiner Patent Office, 904 G St., Washington, D. C. Write for Inventor's Handbook.

SUBSCRIBE NOW for the 1911 issue of the Stationary Engineers' Directory of the city of Philadelphia; $5 per copy. Mail checks to Stationary Engineers' Club, 1108 Arch street, Philadelphia, Penn.

A MECHANICAL ENGINEER, with business qualifications, experienced in combustion and heat transmission, furnace construction and details, desires to represent reliable firm for northern Ohio. Box 415, POWER.

EVERY ENGINEER should be posted regarding the new system of vacuum heating installed without payment of royalty; I have valuable information; write today. T. L. Reeder, 1417 W. Jackson Blvd., Chicago, Ill.

SARCO STEAM PACKINGS—Sales agents with established connections wanted in principal centers outside New York for imported steam packing of exceptional quality and moderate price. Sarco Fuel Saving & Engineering Co., 90 West Street, New York.

CITIZENS WATER COMPANY, Burlington, Iowa. Sealed proposals will be received until noon Saturday, April 15, 1911, for a direct connected centrifugal pump and steam turbine, a waterworks surface condenser and air pump; also for a 16-inch Venturi meter with register and chart recorder; information on application. Frank Lawlor, Superintendent.

FOR SALE

Advertisements under this head are inserted for 25 cents per line. About six words make a line.

FOR SALE—Saunders power pipe machine to take 2½ to 8 inches, complete with dies, guides, countershaft, etc., in first class condition. Address "K," POWER.

FOR SALE—20x48 Wheelock engine and two 72"x18' high pressure tubular boilers in good condition cheap. Address "Engineer," Box 2, Station A, Cincinnati, Ohio.

FOR SALE—One Niles 26 in. x 21 ft. engine lathe, complete with countershaft and attachments; a quick buyer gets a bargain. Platt Iron Works Co., Dayton, Ohio.

FOR SALE—By owner, one 4-cylinder, 12x12-inch, 115-h.p., Bruce-Macbeth gas engine complete, with Wile producer, piping, etc. Address Box X25, Care POWER, 1214 People's Gas Bldg., Chicago.

FOR SALE—One 75-horsepower Weber gas engine, direct connected to generator; one 120-horsepower Jacobson gas engine, belted; one 125-horsepower gas producer; one 160-horsepower gas producer, for anthracite coke; all in good condition and can be seen in operation. Box 417, POWER.

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HOW HOT?

COCHRANE HEATER

"How hot?" is the principal question that the steam engineer has to answer.

How hot is the water entering the boiler? It should never be much below 210° F., nor need it be if it is heated in a COCHRANE OPEN FEED WATER HEATER receiving the exhaust of auxiliaries, as pumps, fan and stoker engines, etc. If the water has been heated to 210° F. by spraying through the steam-bath of the Cochrane Heater, all air and gases, which are essential to corrosion, will have been driven off, and the driving off of carbon dioxide gas will have resulted in the breaking up of bi-carbonates into the insoluble mono-carbonates, which rapidly settle out of the water thus keeping that much scale out of the boiler While the water is hot, it can be easily and conveniently treated with soda ash or other reagent to correct permanent hardness, as in the SORGE-COCHRANE HOT PROCESS WATER SOFTENING SYSTEM.

How hot is the exhaust steam passing to the condenser? This is a better gauge of the vacuum than most vacuum gauges, provided the thermometer be inserted at the steam inlet.

How hot is the tail-water or hot-well water from the condenser? If it is a modern condenser this should not be more than 10 or 15° below the temperature corresponding to the vacuum. Any greater difference indicates imperfect action of the condenser.

By determining **how hot the steam is after it has been wire-drawn through a throttled opening,** the amount of moisture is readily determined, that is, you can make your own calorimeter and appreciate the need of a COCHRANE STEAM SEPARATOR to keep the moisture in the steam out of the engine or turbine.

How hot is the lubricating oil in the bearings? This is an important thing to know.

How hot are the armature and fields of the generator, the switches on the switchboard, and a thousand other things about a power plant?

"How hot" can be answered if you have one of these first-class improved Cochrane thermometers. This thermometer is fitted with a nickel-plated, metal carrying case, with a chain and safety-pin, and has been especially designed for the use of the stationary engineer. **For a limited time it will be sent, together with a copy of our treatise on the**

"Profitable Utilization of Exhaust Steam"

for ONE DOLLAR ($1.00). You could not buy one in the open market at anything like this price. **This offer is open to only one operating engineer in each plant and the name of the plant and the kind of feed heater now in use must be stated.** The book is thrown in so that you may be able to make profitable use of the information about temperatures that you may obtain with the thermometer.

Harrison Safety Boiler Works

17th and Clearfield Sts. Philadelphia, Pa.

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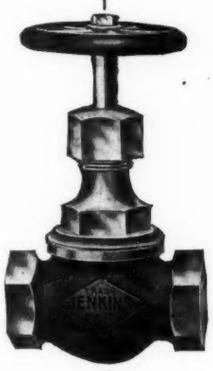


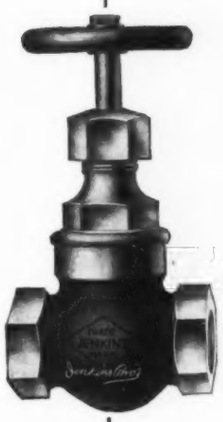
Globe, Standard Pattern

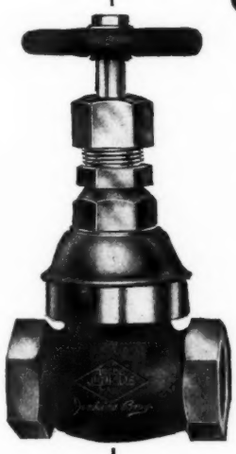
Carefully made of the finest and most durable steam metal, and for regular every day service have proved themselves the most lasting and reliable that money can buy. They are adaptable to innumerable purposes, and are fully capable of standing hard service for years. Have interchangeable parts throughout.

They are furnished either screwed or flanged in sizes up to 3 inches. Also supplied in Angle, Cross, Check, Y or Blow-off, and Safety Patterns.

Globe, Extra Heavy

These high pressure valves are built on the same lines as the Standard Pattern, but are very much stronger and heavier. They have interchangeable parts, including removable seat rings; and the spindles have powerful Acme standard threads. They are designed and guaranteed for working steam pressures up to 300 pounds; and are also well adapted to water or air service, each valve before shipment being carefully tested to 800 pounds hydraulic pressure.



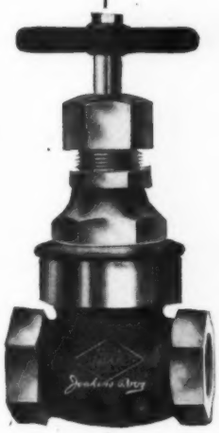


Gate, Medium Pressure

Note particularly the *globe-shaped* body of the valve. This design ensures the greatest possible strength and rigidity, besides securing a valve of good proportions and neat appearance. The valves are well and carefully constructed, and made of very best grade of steam metal. Have good, clear opening through the body, and are thoroughly reliable valves in every respect. Can be furnished with either stationary or rising spindles; screwed or flanged.

Gate, Extra Heavy

Generously proportioned, as you can see from the illustration, these valves will never shirk under heavy duty. They are of strong and sturdy construction, handsomely finished, and like all Jenkins Bros. Valves, put to a severe test before leaving the shops. Like our Medium Pressure Gate Valves, they are of the solid-wedge, double-face type, and are made of the best and most durable steam metal.



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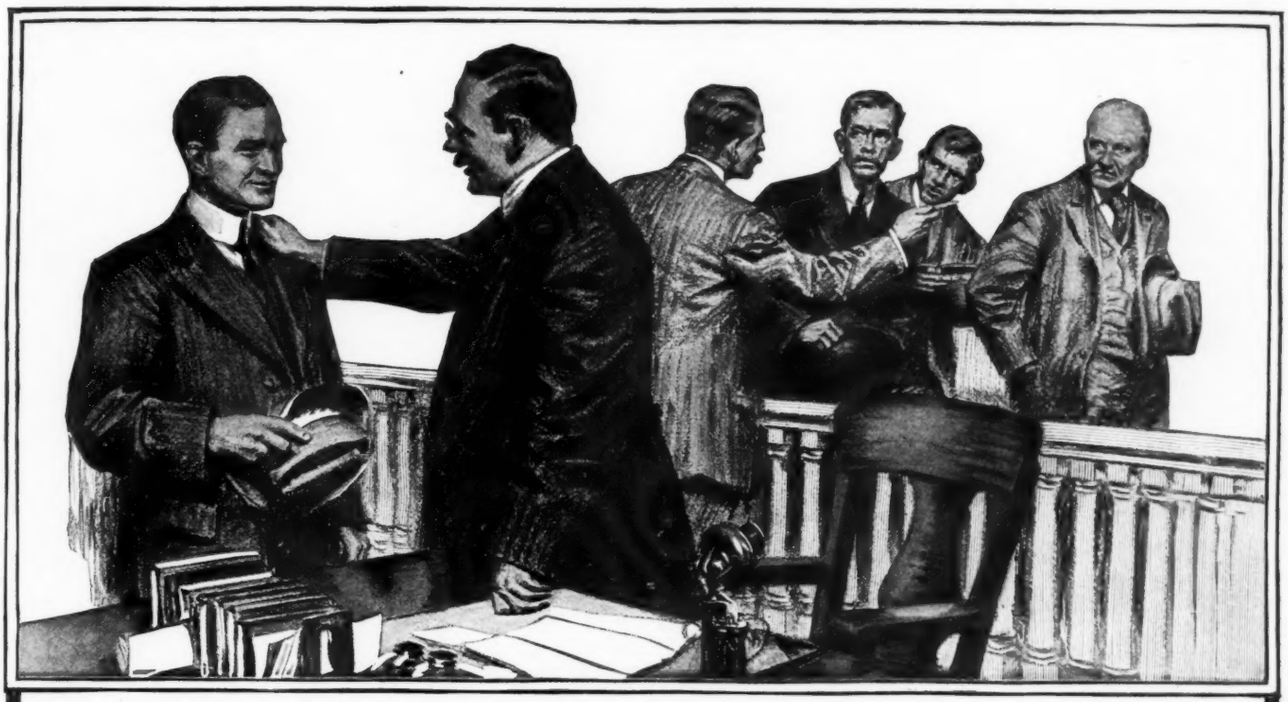

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That's what the trained man, the expert in his line, hears today from the man that hires.

Worth-while jobs are not given out haphazard. The employer has to be shown. Training lands the job—training that means high-grade work and a short cut to results. And training wins quick advancement to still better jobs.

The day of the "Jack-of-all-trades" is passed. This is the time of the specialist, of the man qualified to do some **one** thing to the queen's taste—which means to the satisfaction of a critical boss. No concern can afford to place a high-grade equipment in the hands of low-grade men.

The business of the International Correspondence Schools is to supply training; to give job-getting and job-bettering ability; to raise salaries.

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Goulds Mfg. Co. 100
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Alberger Condenser Co. 101
Allis-Chalmers Co. 100
Worthington, Henry R. 101

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Cameron Steam Pump Wks., A. S. 101
Deming Co. 101

Pumps, Electric
Deming Co. 101
Du Bois Iron Works 112
Goulds Mfg. Co. 100
Westinghouse Elec. & Mfg. Co. 118

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Burt Mfg. Co. 18
Cameron Steam Pump Wks., A. S. 101
Du Bois Iron Works 112
Goulds Mfg. Co. 100
Lunkenheimer Co. 4
Manzel Bros. Co. 82
Sterling Machine Co. 84

Pumps, Oil Force-feed
Detroit Lubricator Co. 84
Lunkenheimer Co. 4
Richardson-Phenix Co. 80
Sterling Machine Co. 84

Pumps, Pneumatic
Ingersoll-Rand Co. 80

Pumps, Power
Deming Co. 101
Du Bois Iron Works 112
Goulds Mfg. Co. 100
Patterson & Co., Frank L. 99
Union Steam Pump Co. 101
Whitlock Coil Pipe Co. 86

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Cameron Steam Pump Wks., A. S. 101
Du Bois Iron Works 112
Epping-Carpenter Co. 101
Goulds Mfg. Co. 100
Ingersoll-Rand Co. 80
Jamieson & Co., M. W. 101
Minneapolis Steel & Mchy. Co. 114
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Wheeler Mfg. Co., C. H. 101
Worthington, Henry R. 101

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Cameron Steam Pump Wks., A. S. 101
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Northern Equipment Co. 77
Squires Co., C. E. 92
Steam Appliance Co. 97
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Hughson Steam Specialty Co. 90
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